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"MACROECONOMIC AND BANK-SPECIFIC DETERMINANTS OF NON-PERFORMING LOANS: ANALYSIS ON A EUROPEAN PANEL OF BANKS"

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ABSTRACT

In my master thesis I wanted to analyse which are the macroeconomic and bank-specific determinants of gross level of Non-Performing Loans in a dynamic panel of 32 European commercial banks.
The sample chosen is composed by 9 European countries, such as Denmark, France, Germany Netherland and Belgium as Western European Nations and Italy, Greece, Spain and Portugal as southern European nations.
The estimators implemented in the analysis, used for understanding if exists a relation between the NPL level and the independent variable chosen, are the GMM estimator, implemented by Arellano & Bond, and the system GMM estimator, realized by Blundell and Bond.
The dissertation is structured as follows:

In the *first chapter* of the research I wanted to underline in which consists the definition of commercial banks, credit risk management, the legal and accounting nature of non-performing loans and how those types of loans have evolved over time;
In the *second chapter* I have analysed which are the main strategy suggested by the authorities in order to solve the NPLs problem, a burden held by the banks
In the *last three chapters* I have reported the literature related to this argument and the model implemented in the analysis with also a discussion of the results found.

According to the model's result, I found a statistical significance on both the macroeconomics and bank-specific determinants chosen in my dissertation, mostly in line with the literature results.

Chapter one: introduction on Non-Performing loans

1.1 Overview on Credit Risk and Commercial banks

1.1.1 Definition of commercial banks

The problem of non-performing loans, or also called bad loans, typically affect commercial banks, since are the financial intermediaries that supply liquidity to individuals.
A commercial bank is defined as a bank who provide loans, preserve customer's money through deposit and furnish the basic financial products, like current account, which main role is to ensure economic stability and grant an economic growth through the services offered.

The legal definition and regulation of this category of financial intermediaries is defined in point (1) of article 4(1) of regulation No 575/2013 of the European parliament and of the council in which the 'credit institutions' are defined as <an undertaking the business of which is to take deposits or other repayable funds from the public and to grant credits for its own account>, different from the definition of investment firm, in which we can find overall functions different from the ones granted by the other type of banks.

The definition of investment bank is regulated by the directive 2004/39/EC, more specifically in article 4(1) point (1) which states that <"investment firm" means any legal person whose regular occupation or business is the provision of one or more investment services to third parties and/or the performance of one or more investment activities on a professional basis>.
These legal difference is useful in order to understand the different services provided by these categories of financial intermediaries and is also important for harmonizing the characteristic between the European Members.
The regulation mentioned before, indeed, defines the prudential requirements for institutions related strictly to banking and financial services both for grant a European definition of those intermediaries both for ensure a financial stability of the operators of those market as well as define protection of investors and borrowers and was chosen the form of regulation in order to ensure that those requirements will be directly applicable on the member states legislation.

Analysing in detail the services offered by commercial banks, beside of legal definition and requirements, we can found the accepting deposit function, one of the primary function,

consisting on keeping the money on behalf of the public, on which, usually, banks pay a small interest to depositors in order to hold their liquidity.
Deposits are divided in three types: savings deposits, owned by small savers on which pays interest; current account for people in business, who can withdraw their liquidity without notice and limit, on these deposit banks do no pay interest; term or fixed deposit, which are deposit that has a limited time and are used if the customers don't have necessity to withdraw that amount for a certain time, here the rate increases will increase with respect to the time's length of the deposit.

Another function of commercial banks is the agency function, which consist in helping their customers on managing their accounts and all the other financial services that they provide, such as trade shares, advisory services for clients that wants to invest their money and act also as a trustees and executors for real estate in behalf of customers.

Other functions provided by these financial intermediaries, over the primary functions, are, for instance, foreign exchange services for the category of clients who works with international trades, such as export and import, by trade foreign currencies in their behalf in order to have best exchange for their businesses.
Also can provide services of custody of valuable assets owned by their customers in specific lockers guarded by bank's vigilance.

One of the main activity provided by commercial banks to their costumers is the lending activity.
This service offered by these financial institution is fundamental for the economic growth and progress, because supply liquidity to people and corporates, essential for the development and the surviving of these individuals.

This activity consists in furnish liquidity and funds for customers, mostly are short-term or medium-term and can grant this service also with a credit creation, means that the banks institute a deposit account in which borrower can withdraw and consume the funds.

Through these activities a commercial bank generates revenues with the charge of interest that the borrowers have to pay and on the other services provided; anyway, the lending activity is one of the source of income most profitable that a commercial bank can provide, since can reach a quite big number of individuals who needs funds for living or continuing their operations.

Otherwise in the deposits is charged an interest that the bank has to pay to the depositors, due to the supply of funds that these individuals grant.
In order to generate profits, however, the interest charged to the borrowers is higher than the one applied to the deposits.

The difference in interest charged between these two types of banking activity (deposit and loans) is called *net interest rate spread*, in particular is computed as the difference between the average yield that the financial institution receives from credit lent to individual, accompanied by other interest-accruing receivables, and the average rate that banks pays to its deposit, opened by the customers, and to its borrowings.
This spread is very important to commercial banks, since is one of the most important factor of a financial institution profitability, in particular for commercial banks.
This spread can be compared as a profit margin, the greater the spread, indeed, the greater are the profit generated by these institutions through this main activity; in contrary, lowest the spread, lowest the profit, or, in worst cases, losses, generated.

The net interest spread is one of the main source of income which can be seriously damaged by the uncollected interest of those borrowers who are unable to repay, the ones who generates non-performing loans.

One of the main risk that the credit institution can face with respect to their borrowers, indeed, is the insolvency of the latter ones, because will reflect a loss in the income statement and a reduction of total asset held, which can become a real and huge problem if the percentage of insolvent or defaulted debtors increases considerably.
In particular, when a borrower faces the insolvency risk, his loan became non-performing, means that the debtor has omitted the payment of the interests or instalments agreed at the beginning of the contract for more than 90 days.
This uncollected payment leads to an increase of capital which the bankers has to set aside given the assumption that the loan will default, and this can cause a reduction of capital available for new loans to provide, and this is the most crucial problem of these type of credits, because can lead to the default of the bank, when the percentage of bad loans held reaches a considerable amount.
A contraction of credit lent, also, caused by the rising of non-performing loans, can cause a slowdown of the economic activity of the country, when this problem affects the financial

system of a nation, because the transmission of money to real economy from banks is interrupted due to the reduced possibility to grant loans.

1.1.2 Definition of Credit Risk

The non-performing loans problem, therefore, has an overall negative impact both on the banking system and on economic system.
In order to grant an efficient system of vigilance on this insolvency risk and on all the risks that a commercial or an investment firm can face during its normal operations was created the risk management department, which is a fundamental section of the banks.

The main risks that affects the banking's operations are:

- Credit risk;
- Market risk;
- Interest rate risk;
- Liquidity risk;
- Operational risk;

All of these risk has their own department in which are studied and managed in order to reduce them as much as possible, so minimizing them.

In order to understand better how non-performing loans, the main argument of mine master thesis, are managed and identified, I prefer to analyse before the Credit Risk, so as to understand how this threat is assessed and handled by banking institutions. Since this section is very important for bank's survivor, I want to deeply focus on this argument, which became, in the last years, one of the most important tool of risk management.

This section of Risk management was heavily implemented in the 10 years before the 2000's, due to the willingness to rearrange the methods of recognition the main factors that can create problems on credit lent.
This process of innovation, indeed, involved various aspects, such as counterparty selection and loan pricing; logic behind credit portfolio composition; the criteria chosen for setting business objectives and performance targets; the degree of independence granted to bank's risk-taking units; the methods for measure results and establishing incentives.

This development of credit risk was particularly useful for innovate the measurements model in order to identify, in a more optimal way, the degree of risk associated to the bank's credit exposures and in order to allow credit institutions to control more efficiently the overall risk-taking capacity, fundamental for avoiding stressful situation which can cause a reduction of profitability and soundness of the bank.

According to Andrea Resti and Andrea Sironi[1] the credit risk is defined as:

> <*the possibility that an unexpected change in a counterparty's creditworthiness may generate a corresponding unexpected change in the market value of the associated credit exposure*>.

This concept implies at least three further notions which are equally relevant in the analysis of these types of exposures.
In detail are:

1. *Default Risk and Migration Risk*: is important to define that, when banks consider credit risk, has not to restrict the concept to the defaulted exposures, but also with a deterioration of the asset held, because also a reduction in creditworthiness of the borrower establishes an expression of credit risk, such as non-performing loans.
   The reason why also the deterioration of creditworthiness is considered in credit risk is because, considering the market value of a loan, the present value of future cash flow will be reduced.
   Concluding, credit risk considers both the risk of default, defined as the risk of loss due to the insolvency of the borrower and the risk of migration, which represent the risk of a deterioration of creditworthiness in credit rating of the individual;

2. *Risk as an unexpected event*: this definition wants to underline that, since has to be considered as a risk, the counterparty default or deterioration must be produced by an unexpected event. When banks issue loans, usually take in consideration the possibility

[1] Definition found on "Risk management and shareholder's value in banking – from risk measurement models to capital allocation policies" written by Andrea Resti and Andrea Sironi in 2007

of default of the borrower, but the events that could trigger the insolvency of the debtor are, even if foreseeable, unexpected;

3. *Credit exposure:* credit risk does not only consider the classical forms of loans issued by the credit institutions (on-balance-sheet and securities), but considers also the off-balance-sheet items, such as guarantees, derivative contracts traded on OTC markets, transaction in securities, foreign currencies or derivatives pending final settlement;

In order to understand better the measurement of risk taken by banks, is useful to define the *expected loss* and the *unexpected loss*.

The expected loss is defined as the mean value of the probability distribution of future losses. This probability is computed at the beginning of the contract by the lender, so that can hedge the position adding the correct spread to the interest rate charged.
In order to calculate this probability, the banker needs three factors:

- *Exposure at default*: means the expected value of the asset in the event of default.
- *Probability of default*: means the probability that the borrower will default
- *Loss given default*: which represent the expected loss rate in the moment of default, so the percentage of exposure that banks identifies as unrecoverable.

The formula became so:

$$EL = \overline{EAD} * PD * \overline{LGD}$$

On the other side, the unexpected loss represents the real risk of credit, since may generate a loss higher than what expected.
Unexpected loss, indeed, is defined as the variability of the loss around its mean value, so around the expected loss.
The distinction between these two types of losses is useful for the composition of credit portfolio held by banks, in particular for the strategies to adopt.
The total expected loss on that portfolio, indeed, is recognized as the sum of total EL and so, in order to reduce the possible future losses which can be generated by this risk, a portfolio manager can diversify the portfolio across sector or geographical areas.
The unexpected loss, instead, cannot be easily hedged, since represent the volatility of the total portfolio.

In order to reduce this risk, portfolio managers have to implement a suitable strategy, which could reduce the overall volatility, by allocating the risk across industries, countries and other categories.
The difference, also, has a specific economic meaning. Expected loss, in a credit portfolio, may cause the rise of provisions for credit risk, which generates a loss in the income statement of that year, since management as to set aside funds for preventing high losses when the event occurs. The provisioning also generates a reserve in banks balance sheet.
The unexpected loss, instead, has not a specific reserve which can be used to reduce the loss that generates, and so the recovery has to be funded by capital granted by shareholders.

Credit risk involves several types of risks, which generates expected and unexpected losses.
In particular, these are:

- *Default risk:* as previously defined, this risk concerns the possibility of default of the counterparty, more specifically when the individual declare bankruptcy, goes into liquidation or defaults the loan for other reason. The loss generated by this category is equal to the product of exposure at default and loss given default;
- *Migration risk:* also this category was briefly described before, and is connected with the deterioration of the creditworthiness of the counterparty;
- *Spread risk:* this risk is linked to the increase of the spread required for the borrowers by the market; this happens if the investors rise their risk aversion and cause an increase in spread linked to the probability of default of the borrower. In this case, even if the credit rating of the individual does not decline, the market value of the security will fall.
- *Recovery risk:* denotes the risk that the recovery rate recorded after the liquidation of the loan of insolvent counterparty will be lower than what was originally recorded, due to a lower liquidation value or due to other external reasons;
- *Pre-settlement or substitution risk*: this risk is related to the probability of insolvency of a bank's counterparty in a OTC derivative, so if the other side will become insolvent before the maturity of the derivative contract;
- *Country risk*: concern the risk that a non-resident counterparty will be unable to meet its obligation due to events of political or legislative nature, as introduction of foreign exchange limitations, which may cause a delay or an impossibility of debt repayment;

All of these specific risks, included in credit risk section, can seriously erode the balance sheet of commercial's banks and generate huge losses on income statement, since the lending activity is the main service that these financial institutions provide.
Credit risk management, therefore, is fundamental in order to grant an efficient administration of bank's assets and for avoiding the bankruptcy.

The most important model used for rate the creditworthiness of borrowers is the Credit-scoring model.
This method is used to forecast the individual's default and is a multivariate model in which, as inputs, are considered the main economic and financial indicator, assigning a weight to each of them in order to forecast the possibility of default.
There are three statistical approaches to compute the credit score of a borrower and these are:

- Linear discriminant analysis;
- Regression models (linear, logit, probit);
- Heuristic inductive models as neural networks and genetic algorithms;

Credit-scoring models are used for two specific objectives:

- Simple default forecasting, in which the analysis is conducted by separating the reliable loans from the riskier;

- Estimates the borrower's risk level, or more precisely the probability of default, by assigning them the PD more appropriate, both in individual basis or in aggregate basis;

The first purpose requires a threshold, in order to understand in which category the loan analysed has to be placed, as reliable or as risky one.
This approach is also useful of understanding if a loan has to be subscripted or not, fundamental for avoid to carry an asset which could easily being deteriorated.
The second use of credit scoring, largely adopted now from many financial institutions, requires the individual risk of the borrowers, the probability of default, which is a fundamental factor used to compute the expected loss on the debt exposure.

The credit-scoring model uses quantitative information in order to define the creditworthiness of the borrowers.
If banks want to introduce also qualitative variables, they could use the rating systems, which is computed both by external agencies, such as Moody's, Fitch, or internally by the bankers.
These estimations are based on qualitative methods, instead of ones more mathematical or statistical used in credit-scoring method, for identify the soundness of the individuals.
The qualitative analysis is based on non-automatic estimations computed by analysts who identifies company's data ad information.
The ratings can be given by financial corporations, such as rating agencies, or by internal ratings, evaluated by the banks themselves.
The differences that can arise from the two different estimations involve specifically three factors: how the borrowers being evaluated; the availability of information; the rater's system of targets and incentives.
Focuses on these differences, can be seen that, overall, banks usually have more information regarding the quality of the borrowers, since rating agencies focuses their assessment on individuals who issues bond on capital markets, meanwhile the internal ratings covers a higher range of customers, such as medium-small firms and retail clients.
The different array of individuals valued is caused by the availability of information. The credit institutions, indeed, has more material to evaluate instead of what the rating agencies can obtain, in particular form small customers.
The last difference regards the reasons that drives the opinions made by these two agents.
The rating agencies objective is to give an independent opinion to the market players. However, these agencies earn fees for the rating issued and so, in order to maintain credibility, tend to evaluate bonds and loans the most robust and precise as possible, in order to not continuously change the creditworthiness of the borrowers.
The internal rating made by banks, otherwise, has to be more dynamic with respect to the one issued by rating agencies, since the valuation provided is used to rate their own loans.
Hence, the rating has to be flexible in order to reflect not only the borrower conditions, but also the economic and financial conditions.
This difference of the two rating system is reflected to the criteria used for evaluate the loans ad the time horizon of the assessment.

In order to better understand how non-performing loans are identified, is useful to understand how qualitative internal rating systems are assigned.

There are some factors which are similar between internal rating and agencies ratings, in particular the financial and economic indicators.
In particular, the probability of default, one of the most important measure used to evaluate the quality of borrowers, which may be differently computed by the two agents.
The main difference regards how the loss given default is assessed.
LGD is fundamental, together with PD, in order to evaluate the score to assign to debtors.
In particular, rating agencies, when redact their verdict, may contain a reduction in the rating of the issuer and the issued loan.
This is explained by the nature of issued instrument, because the latter one is subordinated instrument and so enjoy a lower recovery rate in case of default, so the LGD is higher with respect to the one assessed to the institution which generates that debt and thus the rating may differ.
In the internal rating's made by banks, instead, the LGD is not incorporated on the exposure rating, and so is not involved in the process of valuation, but, in internal rating method, is considered only the probability of default.

Other factors, instead, are analysed only by banks, when issuing their internal rating, and these elements can differ also among banks, but some of them are common for every financial institution, such as: number of rating classes, choosing the appropriate information, setting time and scope of rating reviews.
Focusing on rating classes, retail banks usually uses different number of classes when computing the internal rating.
On average, classes chosen are ten, but the range goes from two simple classes to more then twenty and the ones specific for the problematic borrowers are around three.
Although banks can divide the credit rating only in few classes, evidence shows that a higher diversification is preferred, because, with a higher range, on one side can be prevented high concentration on one single class of rating and in the other side allows a more precise loan pricing.
Rating class, indeed, depends on probability of default of the borrowers. If those are grouped only in few classes, may arise the problem that in a single class are included borrowers whom PD is different and so may be charged an interest rate higher or lower compared to what it would be for their quality.
Analysing the second factor, on the internal rating approach can be found, as information chosen for the estimation, the following:

1. For companies:
    - Economic and financial indicators, directly analysed by analysts and obtained by the financial statement;
    - Qualitative variables, such as management quality, competitive position and so on;
    - Analysis of the state an outlook of the industry in which they operate.
    - Trend analysis on the historical payments, if that company was already been a bank customer;
    - Retail bans uses also information available from the Central Credit Registry or Credit Bureaus, where are included information on loans granted by each banks to that company and the returns generated;

2. For small business or individual customers:
    - Information on payrolls and tax statements of each individual;
    - Qualitative variable, collected in questionnaire that the borrowers has to fill up, which are transformed in dummy variables inside the statistic model used by analysts;

Internal rating system combines both an automatic and human-based resources, qualitative and quantitative information, and this is particularly useful for the assessment because can both reduce the analysing cost, since the evaluation of the small and individual counterparties could generate high cost if analysed only by automatic systems, due to the high customization required on the statistical analysis, both can analyse, in particular large counterparties, the information available even if the sample is not large, which could be distorted by a fully automatic model.

Concluding with credit risk analysis, useful for understand how loans, and so non-performing loans, are evaluated, is correct to understand which are the limits of this management evaluation.
Specifically, the limitations of this approach are four and are given by the fact that is risk measurement is recent and so is in continuous development, even if in the recent years were spent a lot of money and resources in order to improve it.

These limitations are:

- *Treatment of recovery risk*: the estimation models treat this variable as random. This however imply two limitations. The first is that recovery risk is considered as idiosyncratic, but this risk could be partially systemic, when its impact on credit portfolio became relevant. The second one is related to the assumption that recovery risk is independent from changes in default rates while probability of default and loss given default may be driven by common factor and so partially correlated;

- *Assumption of independence between exposure risk and default risk*: exposure at default is usually considered as know, even if the methods used for evaluated it are stochastic. The EAD, indeed, is considered as independent, on models, to probability of default but, in nature, this two risk factor might be correlated;

- *Assumption of independence between credit and market risk*: the statistical models used in credit risk management assumes that credit and market risks are independent. Those two risks, however, are not independent but could be linked together. This criticism, indeed, where studied and implemented by recent models, by treating credit and market risk together;

- *Impossibility of back-testing*: this limitation refers to the fact that, on the outputs produced by the statistical models, is not possible to generated statistically-reliable backtesting procedures. The reason is that market risk and credit risk has two different time-horizon;

In the next sub-chapter, after this initial introduction on which category of bank can issue NPLs and how these financial institutions manage the loan issued, I wanted to give an overview on how non-performing loans evolved during recent years and what could be the main events that have determined an increase of them.

1.2 History of Non-Performing Loans in Europe

Non-performing loans are generating several problems on European banking sector, since this burden reduces the profitability and the soundness of European banks, in particular for the ones located in the southern nations.

The principal event that triggered the non-performing loans problem may be tracked back to the financial crisis, occurred in 2008, because has revealed a huge amount of impaired loans and exposures held by the banks, whom also caused also the bankruptcy of some financial institutions.

In order to understand better how these loans an d exposures were generated, the years before the financial crisis has to be analysed.

During the last 20 years, indeed, the global financial system, and thus also the European one, was affected by a deregulation process and a development of information technology.

Due to these two events, financial institutions started to grant more loans, starting a cycle of credit boom, thus an increase of credit growth has been recorded in the first years of 21st century.

Additionally, deregulation process has not only increased the loans issued by financial institutions, but also the competition among banks, which started to act in order to generate more profits.

The increasing completion and research of revenues affected the bank's credit risk, by increasing it, and so the amount of bad loans on their loan portfolio's started to rise, due to the reduced borrowing's criteria, allowed by the deregulation, and due to the less efficient screening procedures for bad debtors.

This procedure put in place by banks leaded to, when 2008's crisis occurs, an increase in non-performing loan ratio, since is the most important ratio which reflects the quality of credit portfolio.

In euro area, an additional problem occurs, in 2011-2012, and is the sovereign debt crisis.

During those years, indeed, in several European countries the public debt level increases.

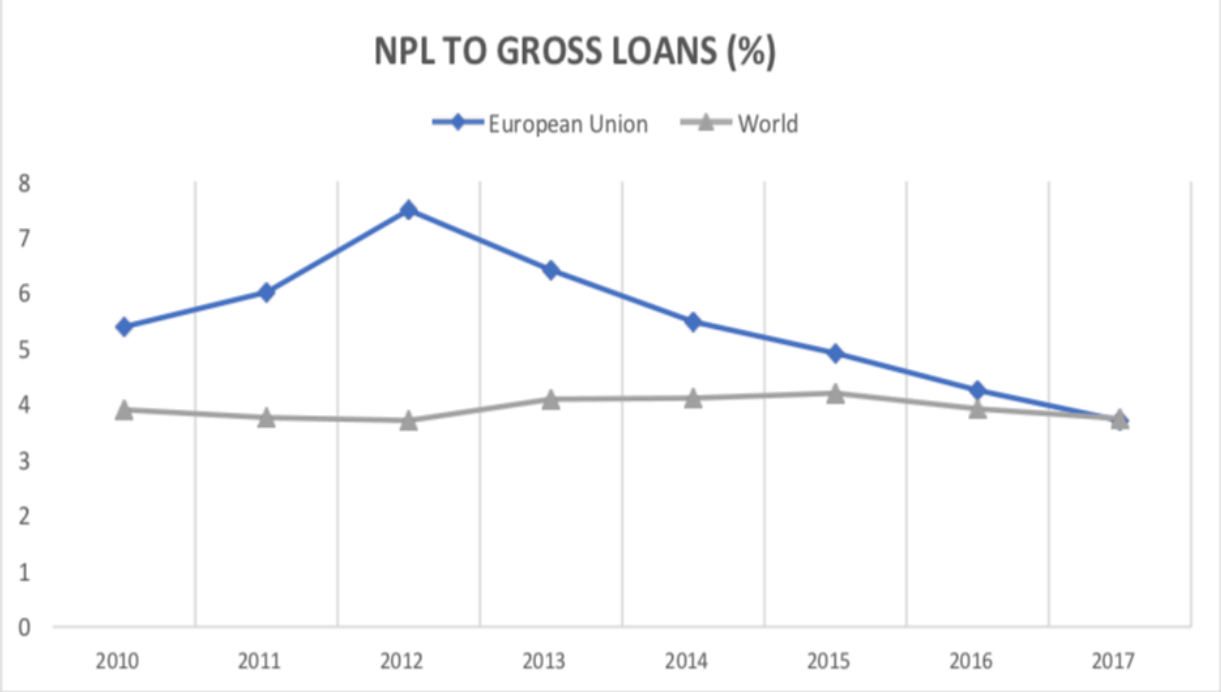
This happens due to the political choices chosen by European Central Bank, who, in line with other central banks, cut short-term interest and issued liquidity denominated in euro on the market. The effect of this political measures, however, had different effects across European countries.

Those measures, indeed, amplified the effects of the global financial crisis, which generates a reduction in growth prospect and requires a revaluation of asset price, especially for those countries who has macroeconomic imbalances.

This situation started in the late 2009; in this period, a number of European nations reported a Deficit over GDP ratio higher than what expected and this leads also to a recession.

This situation leaded also the banks to review their perspective on possible losses on bad loans, which affected sovereign bond values, and so increased the sovereign debt.

This cycle has leaded to an exponential increase in European non-performing loans, which reached the peak in 2012, with an overall ratio, so including al the Euro Area countries, between 7.5% and the evolution of the non-performing loans ratio, computed as the ratio between NPLs and total gross loans, is illustrated in graph 1.



Graph 1[2]

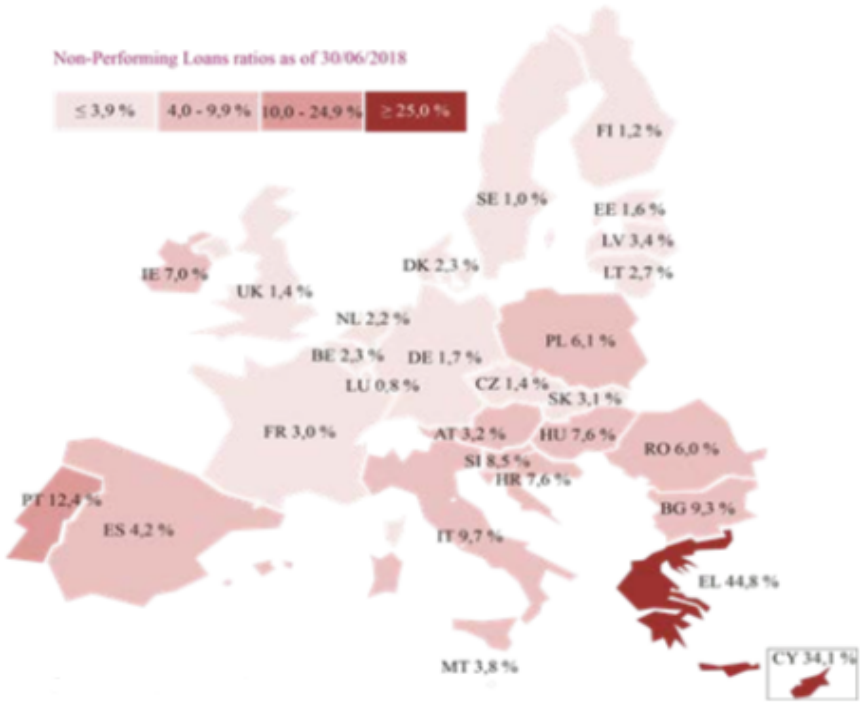
As reported in the Graph, the situation of bad loans in Europe is getting better, gradually reducing the NPL ratio at 3.7%, just below the world average of 3.74%.

The reason of this reduction can be found on the selling activities implemented by banks, whom tries to give away this burden by placing the impaired loan on the market, or, as what has been done in Italy, by selling those to an alternative private investment fund, called Atlante.

[2] *Source: EBF, based on World Bank and IMF data*

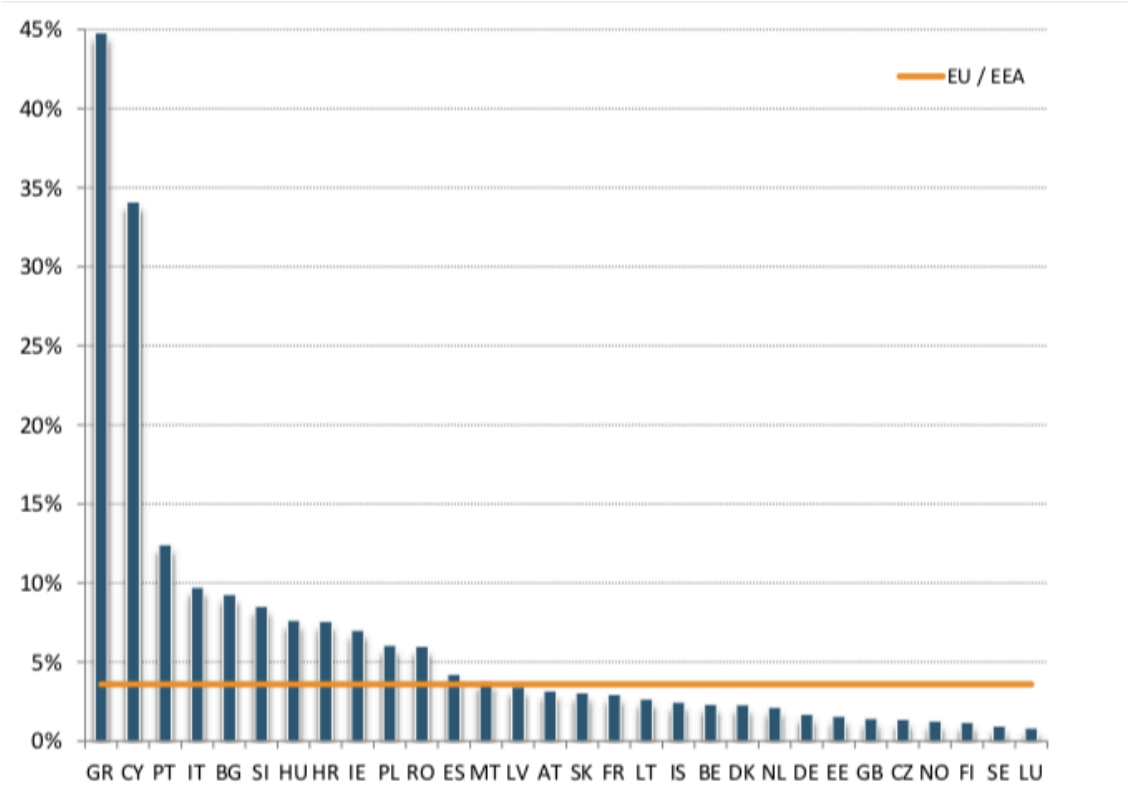
The aim of this investment fund is to collected the bad and doubtful loans in order to remove those from bank's balance sheet and to stabilize the financial and banking sector.
The situation in Europe, however, is still fragmented across European regions.
The actual composition of non-performing loan ratio in Europe is illustrated in the next two graphs.

The bar plot and the map perfectly highlight the situation in Europe, there are several nations which, still in 2018, has a huge amount of non-performing loans held in their loan portfolios, and those are mainly located in the south and in the east of Europe.
Carrying these amounts is very dangerous for banks, their profitability will suffer, since, for solving the problem, the financial institutions have to raise provision, called loan loss provision, used as collateral. The provision is funded by capital generated during the year, so reduce the net income, while the bad loans doesn't generate additional income, since the borrowers did not repay their rates.



Graph 2[3]

[3] *Source: EBA risk dashboard*



Graph 3[4]

The deterioration of balance sheet increases also the riskiness of the bank and the perception of investors. All of these factors were reflected in higher lending rates, lower volume of issued loans and inversed risk aversion.

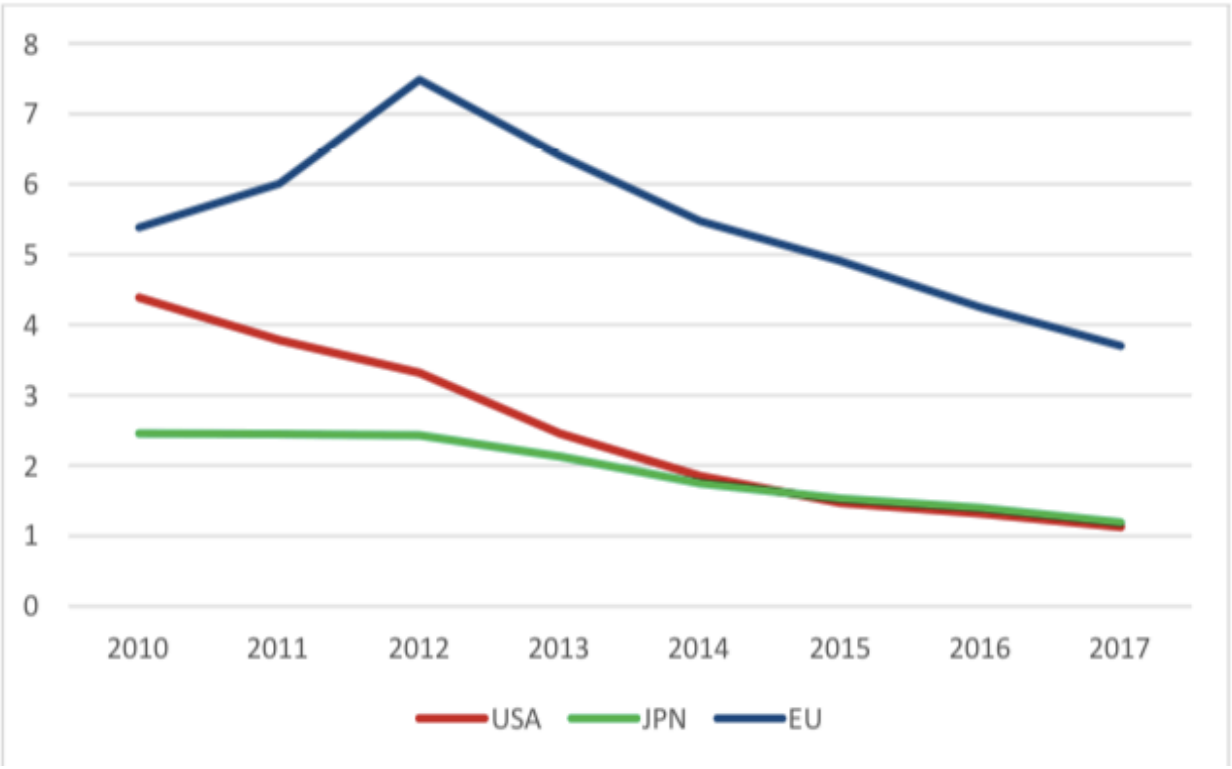
Moreover, if banks slowdown the credit provided, also the economy is affected by doubtful loans, since banks did not grant funds to corporates, in particular to small-medium enterprises, fundamental for their operating activities.

The slowdown of the productivity and profitability of firms lead also to macroeconomic implications, such as a decrease of GDP and an increase in unemployment, but these will be analysed in next chapters.

The non performing ratio decreased through the years, reaching level of 3.7% on 2018.

However, European banking system has still an amount of bad loans, related to the total amount of gross loans, higher with respect the one recorded in other major developed countries (graph 4).

[4] *Source: EBA risk dashboard, Q2 2018, p. 10*



Graph 4[5]

As reported in the latter graph, Japan and USA carries a non-performing loan ratio lower than what is recorded in Europe, more precisely the ratio for Japan and USA is around 1%. The main reason is, again, the high fragmentation of impaired loans across Europe.

The dispersion of non-performing loans across Europe is not s recent event. The NPL's ratio, indeed, differs across the EU countries since the moment in which the financial crisis occurs, so when the credit risk problem became significant.

[5] *Source: The World Bank Data*

Green = less than 5% ; Yellow = between 5% and 10%; Red = above 10%

Figure 1.1

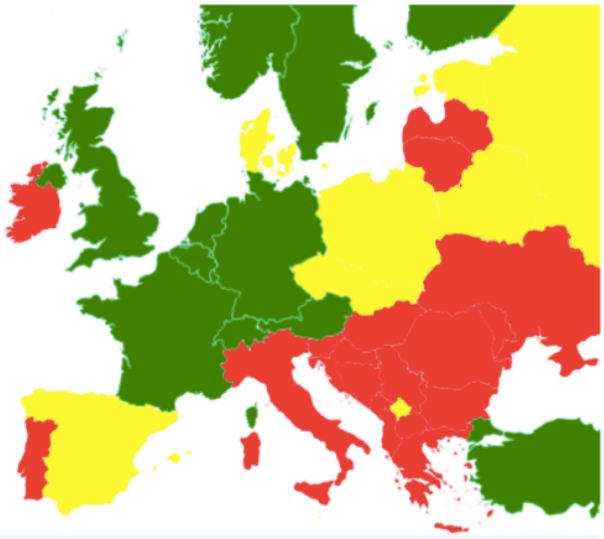


Figure 1.2

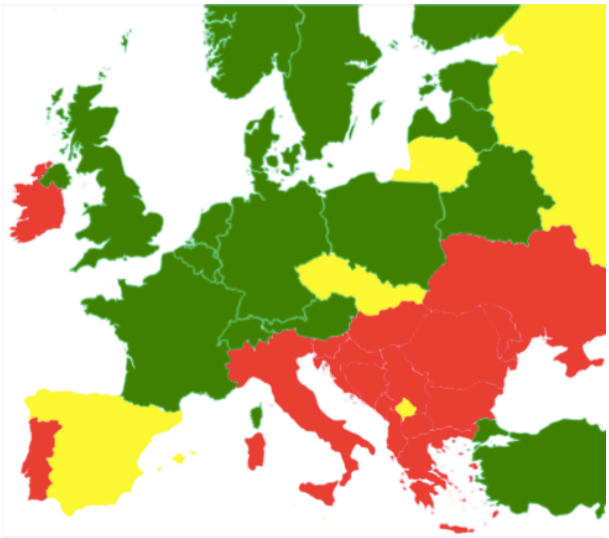


Figure 1.3

The three figures above (1.1, 1.2, 1.3) represent the evolution through time across European countries. In particular, in figure 1.1 is represented the non-performing loan ratio in 2008, when financial crisis occurs; in figure 1.2 is recorder NPLs ratio in its highest peak, so between 2011 and 2012; In figure 1.3 is showed the percentage of bad loans over gross total loans in 2016.
Concluding, the history of non-performing loan in Europe reflect the high fragmentation of those asset held, due to the characteristic of each state and management choices.
This high subdivision, moreover, has negative impact on the economy and banking system of each country, afflicting the profitability of local banks and wealth of citizens. The effect of non-performing loans on the Macroeconomic and Bank-Specific factors will be deeply analysed in chapter 5.

1.3 Definition of Non-Performing Loans.

The financial crisis of 2008 has revealed strong difficulties for comparing bank's information across jurisdiction, in particular on what concern the credit risk, since the methods of valuation for the quality of bank's assets differs across nation.
In order to solve this problem, which affect both supervisory authorities and stakeholders, the Basel Committee decide to institute one task force for analysing the jurisdictions' and banks' practices in order to harmonize rules, on asset categorization, which can simplify the comparison between group of financial institutions.
The definition of non-performing exposure provided by the committee, in order to harmonize the rule, concerns the criteria for classify loans and debt securities which are past-due or the unlikeliness of repayment.

The main aim of this task force was to summarize all the latter definition because there were several differences in credit assessment, in particular:

- For banks, the differences in credit valuation, could rise up difficulties in correctly evaluate credit risk, postponing the recognition of deterioration of asset quality, in particular when supervisory authorities, which may refer to different jurisdiction, evaluate the credit quality;

- Considering the banking system, these differences make very difficult to compare internationally this risk for supervisors and market analysts;

In order to avoid these problems, the Basel Committee, in Basel II, defines the Non-Performing Exposures.

Before define that asset class, is preferable to provide the categories[6] of which that definition should be applied, in particular is related to:

[6] *As reported in Consultative Document of Bank for international Settlement in 15 July 2016*

- <On-balance sheet loans, debt securities and other amount due that bank include in its banking book for the purpose of computing its capital requirements under the June 2006 international convergence of capital measurement and capital standards ("Basel II")>;
- <off-balance sheet items, e.g. loan commitments and financial guarantees>;

The application of Non-Performing Loans is applied the exposures previously mentioned, but is better to focus on exposure nature in order to better understand the application of the rule:

- For exposures to a non-retail counterparty, bank must consider all exposures to that individual a non-performing when every exposure is non-performing, also when the counterparty has more the one exposure with the bank;
- Concerning the exposures to retail customers, has to be categorized as non-performing the single exposure of the client. If the borrower has more than one obligation with the bank, the evaluation has to be computed separately for each exposure held;
- If the exposure is related to a group of connected counterparties, nonperforming status has to be applied to according to the previous rules, but bank has to consider the status of the other connected clients when assign the riskiness of the one connected borrower;

The definition of Non-Performing exposure, described below, will not replace the accounting concepts of impaired asset or default, described in IFRS 9; this definition is a regulatory term that helps supervisors and analysts for comparing the credit risk among different jurisdictions and provide a better ability to recognize the quality of asset held.
Basel Committee considers exposures as Non-Performing when:

- All exposures which are defaulted according to the Basel outline. An exposure is recorded as defaulted, according to paragraph 452 of Basel II framework, when one of both of these events takes place:
    - Bank understand that the borrower will no pay its obligations to the group in full;
    - The debtor is pat due for more than 90 days on any category of credit obligation stipulated with the baking group. The moment in which past due begins is when the customer will breach an advised limit or if will be advised of a limit smaller than current outstanding;

- Exposures that are impaired in accordance with the applicable accounting scheme, which will be analysed below. With impaired is meant assets that faces a downward adjustment due to a deterioration of the quality of the borrower;

- All other exposures that are not defaulted or impaired but has the following characteristic:
    - Credits that are past due for more than 90 days;
    - Whenever there is a proof that full repayment of principal and interest, without the collection of the collateral, is unlike, regardless the number of past due days;

Basel committee provide other useful definitions concerning Non-Performing Exposures, which helps the classification of those assets, such as:

- Collateralization of the debt should not have influence on the identification of a Non-Performing Exposure, since the collateral, granted to the bank at the moment of stipulation of the loan, does not influence the past due status, nor the counting of the past due days, the determination of exposure as non performing or the valuation of the inability to fully repay the loan. The credit instrument, when the criteria are met, is assessed as non-performing regardless the presence of a collateral;

- A counterparty is defined as a <natural or legal person to which a bank has exposures>;

- An exposure is considered past due whenever any amount due, from the borrower to the financial institution, under the obligation of the contract has not been paid at the moment in which that amount should have been paid. The quantity due refers to any interest, principal, fee or other type of obligation.

Furthermore, past due exposures is identified also if the amount is not considered material;

- An exposure is not considered material if reach the <materiality threshold in force in a given jurisdiction>. The threshold should be applied considering the counterparty aggregate exposure or past due amount as what the supervisor has determine, not by applying the bank's internal criteria;

Another important concept reported by the Basel committee concerns the definition of forbearance, which is an important tool useful for trying to recover the non-performing exposures.

The forbearance occurs when a counterparty is facing financial difficulties, (so when the counterparty is past due on one of his obligation, when is not currently past due but is very likely that will not repay some of his agreement in a foreseeable future, when the counterparty outstanding securities were delisted or are in the verge of being delisted, when the bank estimate that the counterparty will be no longer able to repay due to their actual cash flows, when an exposure of a borrower is categorized as an exposure that has already experienced some difficulties in repayment, when the exposure is considered non-performing without concession or when the counterparty <cannot obtain funds from sources other than the existing banks at an effective interest rate equal to the current market interest rate for similar loans or debt securities for a non-troubled counterparty>) in meeting its financial obligation.

The forbearance is intended when a bank decide to grant a concession that, in normal condition of the exposure, will not be approved.
Forbearance includes all the exposure that are classified as loans, debt securities and off-balance sheet items and is not allowed for those assets that banks held in their trading books.

The concession granted by the financial institutions are special contractual terms and condition provided for those borrowers who faces financial difficulties and implies the modification of some contractual conditions in a more favourable way for the customer, by a supplementary agreement or in a new contract used to refinance the actual transaction, in order to recover the amount that will be otherwise lost.
There are several concessions provided by banks, such as:

- Extension of loan terms;
- Rescheduling of payment days of principal or interest;
- Grace period, a period in which borrowers do not have any obligation;
- Reduction of interest rate compared to the one charged to individual with similar credit risk;
- Capitalizing arrears;
- Elimination or postpone of amount due;
- Change an amortized loan to an interest payment only;

- Releasing collateral or accepting lower level of collateralisation;
- Allowing conversion of debt to equity of the counterparty;
- Postponing the recovery or collections actions;

The definition provided by the Basel committee, however, are regulatory classifications.
In order to understand how the non-performing loans are accounted by the banks, is needed a further analysis on the account principal for the impaired assets and loan, recorded in IFRS 9.
In 2014 International Accounting Standard Board (IASB), provided the International Financial Reporting Standard 9, (IFRS 9), an important report in which are recorded several definitions and accounting methods for report and measure the financial instruments.
Non-Performing Loans are recorded in balance sheet as impaired assets and the requirements for identify those assets are recorder in IFRS 9 and are based on an expected credit loss model.

The new model introduced by IASB substitutes the incurred loss model, which was implemented in International Accounting Standards IAS 39, the previous landmark for recognizing the impairment assets.
This new model issue guideline in order to recognize if a financial instrument has increased or reduced its credit quality.
In order to calculate the expected credit loss of financial instrument, as loans, IFRS 9 provide three types of approaches, used for identify the amount to set aside as a loss allowances or as a provision, such as:

1. General approach;
2. Simplified approach;
3. Credit-adjust EIR approach;

According to what reported for **General Approach**, a loss allowances is recognized on a 12-Month ECLs or Lifetime ECLs, depending on the moment in which the credit risk increased.
The modifications of the loss provisions, due to the change in creditworthiness of the financial instrument, are record in income statement as profit or loss, depending on the variation of credit risk.
This approach is composed by three stages, in particular first stage concern the 12-Month ECLs while the second and third stage to Lifetime ECLs, as reported in picture below.

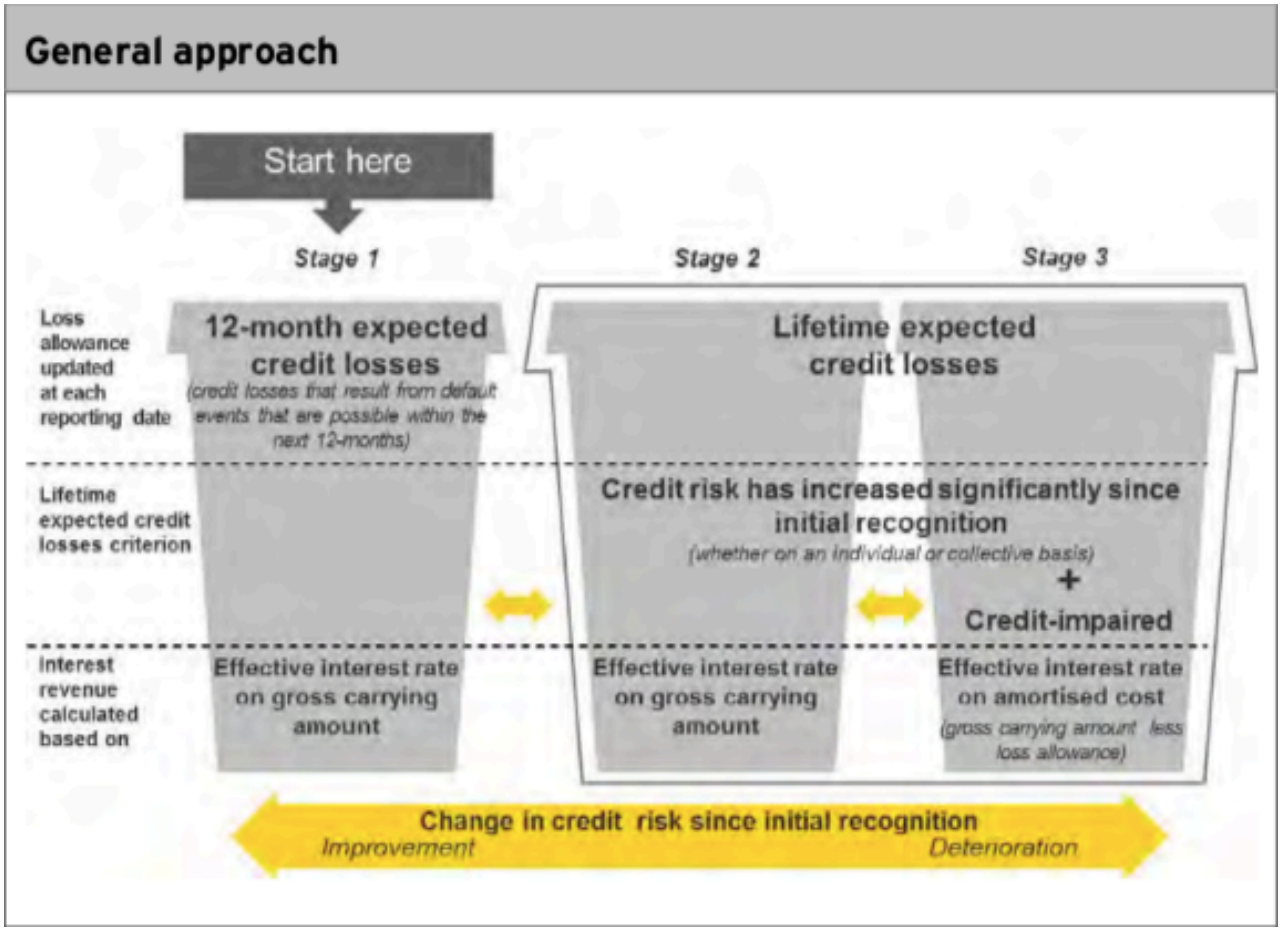


Figure 1.4[7]

The entities have to compute the stages at each reporting date, in order to understand how to modify the allowances and provisions.
Analysing the three stages:

- First stage concerns the credit exposures in which were not recorded a significant increase in credit risk since the initial recognition. For these types of financial instrument is required the 12-Months ECLs, so, in this case, the default events are considered to be possible within a year from the initial recognition. The interest revenue is computed on loan's gross carrying amount;
- Second and third stage is related to credit exposures that has recorded significant increase in credit risk since initial recognition, a loss allowance is required for Lifetime ECLs and not for just a year, since the default events are not considered just for next 12 months but for the lifetime of that financial instrument. The two stages differ for the

[7] *Source: "Impairment of financial instruments under IFRS 9", EY, December 2014.*

categorization of the asset, in second stage the financial instrument faces an initial increase in credit risk while in third stage are recorded those credits who faces a further deterioration of creditworthiness and so recognized as credit-impaired. For the second stage the interest is computed as in the first stage but in the third stage is evaluated basing on loan's amortised cost and no longer on gross carrying amount;

The assessment of the credit exposure is not required if the credit risk variation is small on a financial instrument. Hence, in order to simplify the procedures to evaluate the credit exposures, IFRS 9 furnish the following operational simplifications:

- If a financial instrument is rated as "investment grade", IFRS 9 allow to not evaluate ECLs since its credit risk is low;
- The significant increase in credit risk is identified when an exposure is past due for more than 30 days. In this case ECLs valuation is required;
- If the pattern of default is not concentrated on a specific event during the expected duration of the life of the financial instrument, if arise a change in credit risk during the next 12-months, that change could be reasonably approximated as a change in risk of default for the expected remaining life of the credit. In this case is simplified the calculation of ECLs by allowing to evaluate it with 12-months method, unless the circumstances require a Lifetime calculation of ECLs;

When a financial asset improves its credit quality and is no longer considered impaired, the calculation of interest revenue must be computed by applying the Effective Interest Rate method. Otherwise if the default of a credit is concrete, so there is no longer expectation of the recovery of that instrument, the carrying amount should be eliminated with the write-off of the credit.

The **Simplified Approach** is an alternative method in which the entity charge to compute the changes in credit risk has not to track every variation of the borrower quality but has to record the loss allowance basing on the Lifetime ECLs at each reporting date starting from the origination of the credit.
This approach, however, is required only for those trade receivables or contract asset which do not contain a relevant financial component or for instrument with a maturity equal or lower than one year.

The **Purchased or Originated Credit-Impaired Financial Asset Approach** is particularly useful for recognize if an asset is identified as credit-impaired.
The criteria provided by IFRS 9 are similar to the ones issued by IAS 39 'loss events' and define a financial instrument as impaired if there was one or more than one dangerous event occurred on that financial instrument whom affects the future cash flow of the asset.
The events that can trigger that status are:

- Significant financial difficulty of the borrower or of the issuer;
- A violation of contractual obligations, such as past due o default events;
- If the lender has granted a concession for the status of financial difficulties of the borrower that would otherwise not conceded;
- When borrower is likely to enter in bankruptcy or in financial reorganization;
- Disappearance of an active market for that instrument due to financial difficulties;
- The creation of a financial asset which is deeply discounted in order to reflect the loss incurred in the credit;

For compute the interest revenue on credit-impaired asset is utilized the EIR method, taking into account the initial Lifetime ECLs in the calculation without increase the allowances with the 12-month ECL.
For these assets is necessary a continue monitoring, the entities are required to recognize periodically:

- Cumulative changes in lifetime ECLs since initial recognition as a loss allowance;
- Amount of any change in lifetime ECLs as an impairment gain or loss, recognised as change in in estimation of cash flow compared to the one computed initially with credit-adjusted EIR;

In order to calculate Effective Interest Rate, the issuer, in this approach, has to consider the asset at its amortized cost and not the gross carrying amount.
The definition of Expected Credit Loss (ECL) is defined as <the difference between all contractual cash flows that are due to an entity in accordance with the contract and all the cash flows that the entity expects to receive, discounted at the original EIR>.
The cash flows included in the computation of ECL are all the cash flows generated by the contractual agreements in the expected life of the instrument and the cash flows generated by the sale of the collateral held or other instrument integrated to the contractual terms.

Given this definition of the Expected Credit Loss, IFRS 9 define the two distinction of ECL such as Lifetime ECLs and 12-Months ECLs:

- 12-Months ECL is the portion of Lifetime ECLs linked to the fact that the probability of default for that specific financial instrument will occur in the next twelve months. This method did not consider the shortfall of expected cash flows for the next year, but take into account the effect of the entire credit loss on a loan over its lifetime, weighted by the probability that the loss event will appear in the next 365 days;
- Lifetime ECLs is defined <as an expected present value measure of losses that arise if the borrowers defaults on its obligation throughout the life on the loan>. So represent a weighted average credit loss for the credit portfolio, with the probability of default as the weight.

ECLs arise even if the banks recover all the amount of a contractual obligation but this was paid later than the date in which was due;

These definitions, provided by Basel Committee in Basel II and by International Accounting Standards Board with International Reporting Financial Standards 9, are fundamental in order to recognise the loss that a credit can generated and were strongly required after the financial crisis that affects the world in 2008, since the previous regulation were not equal for all the states.

In October 2016, Basel Committee on Banking Supervision decide also that ECL method must be applied on the methods for rate the credit instruments issued by financial institutions, such as standardized approach and internal rating-based approach, in order to harmonize the accounting and regulatory treatment of provision both in the IASB and Us financial accounting standards. In this way the comparison and recognition of impaired assets and Non-Performing Loans are easily to identify across countries.

Chapter two: Strategies for managing Non-Performing Loans

2.1 Introduction

In the previous chapter I've analysed how the non-performing loans are classified and regulated. In this chapter I want to provide useful information for implement strategies on managing NPLs.

The methods for managing non-performing loans, issued by the European institutions, are addressed to the banks which are in compliance with the European regulation 575/2013, in particular with article 4(1) of the latter regulation.
However, the paper provided by EBA could be more significant for those banks with high level on NPLs, since the resolution of the problem is prior, since the deterioration of the loans could lead to a serious troubled situation.
For banks with high level of NPL is meant those banks who carries stock of NPLs which is particularly higher with respect to the average of the one registered in the EU.
However, the methods for the resolution of impaired loans is useful for all the banks in European Union which carries this burden, not only for the ones in a stressed situation.

The regulatory or accounting criteria provided by the European Regulation or the country legislation, however, are not touched by the guidelines provided by EBA, the latter lines are tool with the aim of explaining what supervisory, with SSM, expects from the evaluation of NPL, in particular on those subjects in which there is a lack of regulations, filled up in the report over mentioned.
If the rules provided by ECB with the guide wouldn't be respected, banks are expected to receive supervisory measures.

The guidance is addressed for the Non-Performing Exposures, in line with the regulatory definition, expressed in the previous chapter.

2.2 NPLs resolution's guidelines

In order to assess correctly the deteriorated exposures, the credit institutions have to evaluate not only the loan itself, by understanding which quality has to be assigned to that asset, but the banking system have to identify also other elements such as:

- Assess internal capabilities to effectively manage the Non-Performing Loans, in order to understand if the management will be able to reduce those assets and the time horizon needed;
- Assess the external conditions that may cause a variation of impaired assets and if the operating environment is able to solve the problem;
- Assess the capital implication of Non-Performing Loans strategy, since provisions needed for reduce the deteriorated loans are charged by capital.

Analysing in detail the initial assessment needed for implement a NPL strategy, its needed to underline which are the key factor that has to be evaluated in order to understand the fully capability of the management for reduce the problem.
The bank, so, has to understand and inspect aspects such as:

- Determinants of the NPL issue:
    - How NPL portfolio has evolved through time and the amount of that portfolio;
    - The drivers of inflow and outflow of NPLs;
    - Other correlation and causations of variation of impaired asset;

- The results of the previous actions implemented for solving the problem, in particular:
    - Which strategies where realized and the outcomes recorded;
    - Understanding which factors drive the success of the actions previously implemented, including the effectiveness of forbearance measures;

- Operational capacities of the management for the different steps of the strategy implemented, as:
    - Early warning and detection of NPLs;
    - Forbearance measures;
    - Provisioning management;

- Collateral valuations;
- Process implemented in recover impaired assets;
- How forbearance was managed;

All of these key factors are relevant for understanding how to implement a strategy for the reduction of non-performing loans, in order to understand how to build the strategy and which previous actions has provided efficient results.
The banks should implement a self-assessment in order to understand the strength and weakness of the bank management, in order to understand how to proceed.

Beside the valuation of internal capabilities, the banking analysts has to evaluate also the external factor and operational environment, for understanding how the strategies has to be implemented.
Regarding the external factors, is particularly important to assess the:

- Macroeconomic conditions, in order to understand the context in which the bank has to operate. If the banks non-performing loan portfolio has a specific concentration in a particular sector, the bank shall deeply analyse the sector;
- In order to, also, understand the rapidity and the time horizon for reducing the carrying amount of deteriorated asset, is important to assess the expectation of the external stakeholders, since the judgement of those individuals, such as rating agencies, market analysts and so on, could slow down and delay the strategies, since could give a negative judge. The banks, hence, has to understand how the external individuals evaluate the bank's status;
- Is important also, in order to implement a successful strategy for reduce NPL, to understand which are the dynamics and the demand of NPL market, fundamental for recognize if can be found a counterparty for the sale of that type of loans and for pricing those;
- The last important external factor that has to be taken into consideration in order to provide a successfully strategy is the regulatory, legislation and judicial framework. Different nations and legislations, indeed, could differently regulate loan loss provisions and collateral, fundamental for recognize how to price NPLs and for estimate also the exposures at default. In particular banks has to assess the legal procedures linked to NPL in order to evaluate those according to different legislations and different type of assets.

- Last external factor which has to be taken into consideration for implementing NPL strategies is the tax implications, of national legislation, of provisioning an NPL write-off;

Concluding the elements to evaluate for understand the operating environment, banks have to follow the capital levels and trend, since are fundamental for deciding which actions could be implemented for reduce impaired exposures.

Before reporting how the NPL strategy have to be implemented, according to the guidelines provided by the European Banking Authority, is better to understand how the life cycle of NPLs is determined.
The life cycle is identified throw three phases, such as:

- *Early arrears (up to 90 days past due)*: this is the initial phase of deteriorated exposure. During this initial phase the banks should focuses on initial commitment with the debtor for early recoveries and should collect information in order to understand the borrower's status, as financial situation, motivation of past due payments, status of collateral etc.

Bank's management, in this phase, have to identify the most suitable strategy according to the type of the exposure to recover and the collateral linked to that exposure;

- *Late arrears / forbearance /restructuring:* this phase occurs when lender and borrowers meets in order to implement restructuring and forbearance measures with the counterparty in order to try to not lose all the amount of the exposure. After the agreements of the forbearance/restructuring agreements, the debtor should be constantly monitored, due to their increased credit risk and because, if the agreements are successful, they may be transferred out from the NPL category;
- *Liquidation / Debt Recovery / Legal Cases / Foreclosures*: this phases concern all the borrower in which the second phase is no longer possible due to their financial situations or because did not want to collaborate. In these cases, banks should realize a cost-benefit analysis in order to understand which strategy is better to implement for recover as much as possible with a low cost.

Given all this information, about life cycle of impaired assets and the key factors that are necessary to be considered, the Non-Performing Loans management can start to develop a strategy for the reduction of that particular asset held.

In order to implement a successfully strategy, bank's management has to initially define the time targets of NPL, since the strategies differs basis on the time horizon decided.
The targets chosen has to be linked with an operational plan, which is based on a self-assessment and an analysis of NPL strategy implementation options.
Considering so the above mentioned assessments, bank should choose between the following options for developing a strategy to reduce Non-Performing Loans, which are not mutually exclusive:

- *Hold/forbearance strategy:* forbearance strategy occurs when lenders apply forbearance measures agreed with the borrowers for improve the contracts obligations; a hold strategy is closely link to the bank's operating model, operational NPL management and their behaviour on write-offs policies;
- *Active portfolio reductions:* concerns in the sale, securitisation and write-offs of the Nonperforming exposures. This strategy is strongly associated with the collateral of the exposures, the adequacy of impairments, the NPL investors demand and the quality assigned to the loan;
- *Change of exposure type:* this strategy includes foreclosure measure, debt-to-equity swapping, debt-to-asset swapping or collateral substitution, hence every measure to change the nature of the deteriorated exposure;
- *Legal options:* occurs when the credit institutions put in place insolvency proceedings or out-of-court solutions;

Is better than bank's includes, in their comprehensive strategy not only a single option, of the ones above mentioned, but is better to combine them in order to implement a stronger strategy for achieving their short, mid or long term objectives.

Beside the nature of chosen strategy, credit institutions should determine a long-term horizon of NPL levels, both for single portfolio and at aggregate level.
Setting the targets in particularly important, because clarify the ambitions of the management and illustrate the soundness and capability of the credit institutions to solve the burden linked to Non Performing Exposures.

The defined targets should lead to a concrete reduction of the net and gross carrying amount of deteriorated assets, at least in mid-long term, since in the short term is difficult to reduce them since is a complex and long process.

The targets that banks should determine are:

- *Time horizon:* divided in short-term, around 1 year, mid-term, around 3 years and long-term;
- *Main portfolio:* targets linked to the principal composition of the portfolio, such as retail mortgage, retail consumer, retail, small medium enterprises, corporate, large corporate and commercial real estate;
- *Implementation options:* chosen when banks drive the reduction with strategic options, such as cash recovery from hold strategy, collateral repossessions, recoveries from legal proceedings, revenues from exposure's sale and write-offs;

After the decision of the targets, the credit institutions should also forecast and project the amount or percentage of Non-Performing Loans reduction, for the main portfolios held by the banks. This procedure is very important because gives to the main stakeholder and to the market participant positive signals of goodwill of the management, strongly relevant since those agents could influence the time of recovery of NPE.

The NPL department of a credit institutions, after having decided the strategy and the targets for the recovery, should implement also an operational plan, which has to be approved by the management body, in which will be represented how operationally the bank will manage the strategy chosen.
Is required by EBA that the operational plan should contain at least:

- Time horizon chosen and objective chosen;
- Activities to implement for every segment of portfolios held;
- Governance arrangements including the responsibilities and reporting mechanism for every activity and outcome chosen;
- The standard of quality of the operation in order to grant successful results;
- Plan for improving the technical infrastructure for increasing the abilities of the agents;
- Identification of budget requirements both for single exposures and in consolidated way for the realization of the NPL strategy;
- Plan for granting the communication with internal and external stakeholders;

The operational plan and the NPL strategy implemented by the credit institutions, before actuate it, have to be fully embedded with the risk control framework, in order to analyse the riskiness

of the strategy itself and if the strategic plan is compliant with the risk measure required by European Union. Special attention, so, has to be given to:

- ICAAP: (International Capital Adequacy Assessment Process) all the activities and choices implemented in the strategy has to be aligned with the requirements reported by ICAAP. In particular, high NPL banks have to prepare a quantitative and qualitative valuation of NPL evolution under stressed conditions and analysing also the impact on the capital;
- RAF: (Risk Appetite Framework) the plans has to be in line with RAF metrics and limits approved by the management of the bank;
- Recovery plan: if some of the NPL related indicator are embodied in the recovery plan, bank's management have to ensure that those actions are in line with NPL strategy;

Beside this risk framework, banks with high level on impaired assets have to report their NPL strategy and operational plan to their Joint Supervisory Team every first quarter of each year, since these bank are riskier than the others.

All of this guidelines, from the key factors of NPL to the operational plan, should be managed by an apposite workout unit (WU), which has to be separate from the loans section, hence the segment of the bank which originally issued and originate the deteriorated loans.

The working units are chosen by the management of the bank who, besides of choosing WU, has specific duties, such as:

- Approve annually NPL strategy and operational plan;
- Supervise the strategy implementation;
- Delineate management purposes and underline incentives for NPL activities;
- Monitor the progress of the strategy according to what were the targets defined in it;
- Define an adequate approval processes for WU decisions;
- Approve NPL polices and ensure the comprehension by all the staff;
- Ensure efficient internal controls for the NPL management processes;
- Ensure that the management of NPL is sufficiently expert and competent;

The management body, hence, has to satisfies all of these duties in order to grant an efficient resolution and reduction of NPL portfolios.
The operating activities, however, are managed and implement by the working units.

The composition and activities of the working units are:

- WU should be created according to the life-cycle of NPL described above, in order to implement an operational plan in line with the nature of deteriorated exposures to recover. Banks with high level of NPLs, moreover, should set up a working unit for each stage of life on NPL, since the resolution for those credit institutions is more difficult;
- When creating the WU, banks have to take in consideration, beside the stage of life cycle, also the portfolio composition of NPLs. The analysis of the NPL portfolios held by the banks should be actuate with a high degree of granularity, with specific definition of borrowers segments, in order to implement an efficient and specific strategy, due to the simplification of the procedures for individual with the same nature;
- Is extremely important, moreover, that the individuals chosen for working on the WU are experts and has all the necessary knowledge and experience for managing this particular asset. The working units, so, have to be composed by experts, hired for specific NPL tasks;
- Beside of the experts needed for WU, is fundamental also that the banks will provide an adequate technical infrastructure, which allows working units to easily access to relevant data and documentation; efficiently process and monitors NPL workout activities; define, examine and measure NPLs and related borrower;
- For NPL WU is fundamental also that banks should implement an efficient control process, in order to align the NPL strategy, operational plan and the overall business strategy of the bank with eth risk appetite. The control framework is composed by three "line of defence", as:
    - *First line of defence:* involves control mechanism within the operational units which own and manage bank's risk in specific NPL workout, focusing on working units. Key tools for this line are the adequate internal policies, which should be incorporated into the IT procedures;
    - *Second line of defence:* embodies functions for ensuring that the first line of defence is operating as intended on a continuous basis. For this line is required a strong independence from the other business activities. The second line should focus especially on: monitor and quantify NPL risk both for individual exposure and in aggregate basis; review performance of overall NPL strategies and operating plans; assuring the quality on every phase of NPLs, from processing

to the valuation of it; review the alignment of NPLs process with the internal policy and public guidelines;

- *Third line of defence:* this line includes usually internal audit and should be fully independent from business activities and, if the bank has high level of NPLs, are needed expert in order to provide an efficient and effective control on NPLs framework. This line of defence is responsible to verify adherence to internal NPL-related policies and to EBA guidelines;

These are the principal guidelines provided by the European Banking Authority concerning the recognition and the strategies for solving the NPL problem, which affects several banks across European Union, in particular southern states.
The instructions provided, however, are advices and suggestions which bank's management has to be compliant with but every credit institution could create its own strategy taking into consideration its specific characteristic and exposures, in order to implement an optimal strategy for the reduction of NPE.
In the further section I wanted to furnish additional, more specific, policies, postulated by Bank of International Settlement (BIS), useful for solve and recover NPLs.

2.3 NPL's Polices instrument

The previous guidelines provided by EBA are advices set for the resolution of the deteriorated assets but does not take into consideration the characteristic of the credit institution itself and in which contest the strategies has to be implemented.

Other strategies, similar to the ones reported by the EBA's guidelines, were implemented, in 2017, by the Bank for International Settlements (BIS), which takes into consideration the characteristic of the loan originally issued form the commercial institutions, when implementing a strategy for the recovery of the impaired loans, and the economic situation.
In particular, BIS furnishes these policies due to the systematic risk that NPLs has generated, both for European countries and for the rest of the world.

The policies implemented can be summarized in the table below, in which are briefly explained.

Policy instruments to resolve systemic NPLs	
Debtors (non-financial companies)	
Policy instruments	How it works
Debt restructuring, including out-of-court workouts	Either corporate or loan restructuring, involving the banks that are creditors to the same customer
Banks	
Policy instruments	How it works
Write-off	Loans are written off from banks' balance sheets
Direct sale	Banks or AMCs sell NPLs in dedicated markets
Securitisation	Banks, special purpose vehicles or AMCs pool and tranche loans and sell the securitised products in dedicated markets
Asset protection schemes	State-backed entities offer insurance on loss on NPLs in order to restart banks' credit provision
Centralised asset management company (AMC)	Dedicated companies buy bad assets from the problem bank(s)

Table 2.1[8]

The policies are divided into two macro categories, in one hand the strategies are focused on the nature of the debtor, valid if the borrower is not a financial company, and in the other hand are focused on the characteristics of the bank.

Starting with the debtor-focused strategies, BIS individuate two different solutions:

- *Debt Restructuring:* is the standard strategy for restore the borrower's capability of repayment and consist in renegotiating the debt in order to reduce the carrying amount of NPL. The procedure has legal implication and is necessary to open a legal process for completing the strategy. These two problematic, the rising of provision required and legal implications, tend to make the banks hesitate from actuating this strategy;
- *Out-of-court workout:* is a cheaper and faster tool since did not require a judicial process for restructure the debt. Under this approach the credit institutions will redact a workout plan for recover the debt instrument. Since this tool could not be sufficient to re-establish a loan as performing, beside this workout is necessary a monitoring program of the customer;

Debtor focused programs resolution mechanism faces some limitations. In particular, is important to underline that this procedure is not a form of forbearance since is not an instrument

[8] *Source: Financial stability Institutions – Resolution of non-performing loans – policy options, Bank for International Settlement, 2017*

for postponing the problem but is a tool for restore the quality of the deteriorated loan. Furthermore, the other limitation of this process is that is typically used for corporate loans, rather than the other types of loans. Finally, the last limitations of this instrument is that is difficult to implement in crisis periods, since the bank's capacity of restructure debts is greatly reduced due to the financial distress faced. In these circumstances is better to implement an out-of-court strategy.

The other category of strategies is the bank-focused resolution instrument. These strategies can be realised by the banks themselves or the authorities can directly apply these procedures when the situation make it necessary.
The instrument available by the banks for the reduction and resolution of NPL problem are:

- *Write-off:* is the simplest way for eliminate the NPL on bank's balance sheet by generating a loss in the income statement counterbalanced by the loan loss provision. Is useful for not accumulate that type of asset. However, banks hesitate to implement this procedure since has a negative effect on capital and profits since the written off of the NPL is followed by a reduction of the capital of the banks, since the provisions needs to be reduced for covering the loss generated. This strategy, indeed, is based on the banks' capital buffers and on the level of the loan loss provisions cumulated. If the provisions are too low, banks can reduce NPL by small amounts, because the loss generated for a huge reduction will directly affect the bank's capital;

- *Direct sale:* is another instrument useful for reduce NPLs by selling them to a counterparty, typically another financial institution, banks or investment funds. In order to sell those assets, banks need to provide to the potential buyer all the information needed to conduct a due diligence.
  The success of this strategy depends on the structural characteristic of the deteriorated loans. Firstly, the application of this approach is not feasible with SME or individual Non-Performing Loans since those type of impaired assets has high information costs needed to evaluate them. Secondly, transaction cost could limit the selling of these assets, since the markets in which NPLs are traded are not liquid nor deep. Another problem which concerns the selling of these assets is the pricing of it. Buyers and sellers has a problem of asymmetric information which can create a large bid-ask spread making harder to trade impaired loans;

- *Securitisation:* this approach is more complicated, compared to the previous ones, but can grant the possibility to reach a greater number of possible buyers. In this process the cash flow of NPLs are pooled together in order to create a security with three tranches, senior, mezzanine and subordinate. The investors are paid following the riskiness of the tranche chosen, firstly the senior, then the mezzanine and finally the subordinated, with all the amount accumulated from the NPL's cash flows generated by the ones pooled together. The advantage of this strategy is that the diversification reduces the risk of the single deteriorated asset and thus buyers can choose the risk-reward combination that they prefer. Another advantage is that, in the securitization process, all the type of NPL are chosen, also, indeed, SME and individual NPLs, difficult to solve with the previous strategies. The collateral of NPLs reduces the risk of the tranches in which that impaired loan is collocated and so could make the investors more attracted;

- *Asset protection schemes:* are particular insurance schemes that supports the banks with high level of NPLs. This procedure was actuated usually during the crisis and concern in the help of a state agency who offers to cover a certain amount of NPL loss against a fee. The main aim of this strategy is to support the credit institution who carries impaired asset in order to avoiding that provisions will be greatly reduced since reflects also a reduction of bank's capital and for avoiding a credit crunch. However, APS tend to be addressed to few large domestic bank instead of a multitude of credit institutions, due to the fact that the instrument is a typically crisis-related tool and in those circumstances the nation want to preserve their banking and financial system by ensuring that large institutions will not goes into bankruptcy;

- *Asset management companies:* AMC are companies to which banks can transfer their deteriorated assets. The main purpose of these companies is to recover the value of the impaired asset, if possible, both by maximizing the profit that can be obtained or by minimizing the possible loss that can generate. The benefit that this strategy to solve NPL's problem is that, through this approach, banks can preserve their loan loss provisions and preserve financial stability and also can create a liquid market for NPLs. The success of AMC is given by the capacity of the latter to recover the value of the deteriorated exposures that the original lending bank have failed to manage, so have to possess better management skill with respect to the ones owned by the original credit institution. The principal operation set up by AMC, before trying to sell it into the

market, is to set up an adequate transfer price for the asset. AMC should price the asset by discounting the future cash flows if the transfer of NPLs does not take place in market. The selling bank have to agree with the transfer price;

These are the principal option, reported by BIS, useful for solve the NPL problem after that have occurred, but does not take into consideration some strategies for avoiding the issue of deteriorated loans, such as more controls and monitoring from the loan department on the loans granted and on the credit quality of the borrower, in order also to avoid asymmetric information, in particular moral hazard, that may rise, since the borrower could have not been completely correct when has reported the information for opening a loan agreement.

In the table below, however, are reported which on the strategies suggested by BIS recorded a success in the country selected.

NPL resolutions in selected jurisdictions (main resolution instruments) Table 2

		Main NPL resolution instruments[1]					
	Crisis episode	Debt restructuring & out-of-court workouts	Write-offs	Direct sales	Securi-tisation	Asset protection scheme	AMCs
United States	S&L crisis	√	√	√	√		√
	GFC	√	√	√	√	√	
Sweden	Nordic crisis		√	√			√
United Kingdom	GFC		√	√		√	√
Ireland	GFC		√	√			√
Italy	GFC		√	√	√		
Spain	GFC		√	√			√
Japan	Japan. crisis	√	√		√		√
Korea	Asian crisis	√	√	√	√		√
Malaysia	Asian crisis	√	√		√		√

Table 2.2[9]

The next chapters concern mine personal analysis on which are the main determinates on NPL in some European countries, in order to understand which macroeconomic or microeconomic variable affects impaired assets, fundamental for the initial assessment of NPLs and for the implementation of a resolution strategy.

[9] *Source*: *Financial stability Institutions – Resolution of non-performing loans – policy options, Bank for International Settlement, 2017*

Chapter three: Literature review

The literature of determinants of non-performing loan has been greatly implemented in recent years, due to the recent distress that this type of loan has caused on financial system, in particular on bank's riskiness.
There are several papers that introduce and analyse this argument, in order to understand which are the main factor that affects the variation of NPL, divided in Macro factors and Micro factors (bank's specific factors).

The macroeconomic factors, examined by the literature, that influence the stock of non-performing loans are several, as: unemployment rate, the annual GDP growth, real interest rate, inflation rate etc., the main bank specific factors included in literature researches are: ROA, ROE, inefficiency ratio, loans growth etc. and where taken into account several countries and several banks of different continents by the authors, mostly are those nations that face lot of problem during the financial crisis.

The determinants of households non-performing loans, so divided only for one category, were studied by Rinaldi & Sanchis-Arellano (2006) who investigate the macroeconomic variables which affect the impaired loans in the years just before the financial crisis, from third quarter of 1989 to second quarter of 2004.
The database used consist of quarterly time series selected for a panel of European countries, in particular Belgium, France, Finland, Ireland, Italy, Portugal and Spain.
The independent variables chosen for the estimation model are: ratio of total household debt to household income; real disposable income per household; ratio of household's gross financial asset to disposable income; real lending interest rate; unemployment rate; inflation rate; household price index; proxy of share of collateralized loans.
The econometric estimation selected was a dynamic model based on panel data, specified as an error correction model.
The results highlights that, in long run, an increase in ratio of indebtedness leads to an increase of NPL's.
However, this effect is offset if that ratio is followed by a rise in disposable income. In long run also inflation and real lending rate affects the financial situation of households positively, so increase the impaired loans held by banks fort this category.

Additionally, the household wealth and the share of collateralized loans appears to be significance and tend to reduce the amount of NPL's.

Messai & Jouini (2013) tries to figure out the determinants of non-performing loans taking as sample 85 banks of three European countries, Italy Greece and Spain from 2004 to 2008.
In this study the Macroeconomic variable chosen were the rate of GDP growth, unemployment rate and real interest rate and the bank specific variables taken into analysis were ROA, the change in loans, and loan loss reserves to total loan ratio with a panel data model.
The research finds out that GDP growth and ROA of banks has a negative correlation with the stock of non-performing loans.
However impaired loans have been positively affected by unemployment rate and real interest rate, so when population face a high unemployment and rate of interest are raised by the financial institution, the NPL ratio tend to raise.
The authors find out also another positive correlation between NPL and loan loss reserve to total loan ratio, means that when banks uses loan loss provision in order to control earnings induce an increase in impaired loans.
All the variables taken into account by the authors were statistically significant, except of change in loans, that result as not significant.

Another analysis made in the Eurozone is the one proposed by Makri et al. (2013) who investigate the determinants of non-performing loan rate in Eurozone banking system over nine years from 2000 to 2008, in order to understand which factors affected the ratio upper mentioned in the period before the financial crisis, because in that period credit increase significantly, due to deregulation and development of information technology, and this may cause an increase in impaired loans.
The authors analyse the factors among 14 European countries and set as Macroeconomic determinants the debt/GDP ratio, the government budget deficit or surplus over GDP, annual growth of GDP, annual inflation rate and unemployment.
The bank-specific factors analysed were NPL ratio lagged for one year, bank capital and reserves to total asset (which determines the risk behaviour of banks), loan to deposit ratio, ROA and ROE.
According to their econometric analysis, made with a difference GMM estimator on a panel data, the authors find out a positive correlation with NPL lagged for one year, the public debt and unemployment rate.

Moreover, they find a statistically significant negative correlation between impaired loans and bank capital and reserves to total asset, ROE and GDP growth.
The other variables examined by the paper doesn't have a statistically significant relevance on the stock of NPL for the year before the financial crisis.

An alternative interesting paper that analyse the Euro-area banking system is the one redacted by Dimitros et al. (2016).
The sample was composed by commercial banks of 15 euro-area countries and data was taken quarterly from 1990 to 2015.
The determinants analysed are similar to the previous paper but these authors find out different results, find with two econometric panel data models, one static and one dynamic.
The dynamic one was implemented with GMM estimator.
The factors that affects NPL chosen in this paper are: macroeconomic variable as unemployment rate, tax income as percentage of GDP, government budget balance as percentage of GDP, debt to GDP ratio, growth rate of GDP, inflation rate and output gap, which is a proxy of the business cycle.
The bank specific variables are: ROA, ROE and Loan to deposit ratio.

This paper provides interest results comparing them with the previous one. As Makri et al. (2013) these authors find out a positive correlation between the NPL of previous year, the unemployment rate and public debt and also fin a positive correlation between the impaired loans and the tax income ratio, so when personal taxation increases, the population face problems to repay their debts and this leads to an increase on non-performing loans.
Furthermore, the paper finds out a strong negative correlation between ROE and GDP growth, as in the previous paper, but this one find a statistical significant also to other two variables, such as Loan to deposit ratio and ROA, which one, in the other paper, has no significance.
The return on asset has a negative correlation with NPLs, while the loan to deposit ratio has a positive correlation with the NPLs.
Finally, the results illustrate a strong correlation with the output gap variables, more precisely a negative correlation, means that business cycle tends to reduce the stock of impaired loans.
This highlights that management efficiency and risk behaviour affects the amount of over 90 days past due loans, same as macroeconomic factor.
A further analysis that investigate the amount of Non-Performing Loans in a developed nation is the one redacted by Saba et al. (2012), which examine the dependent variable in the US banking sector.

This study is based on both the Macroeconomic and the bank-specific determinant factors, analysing the banking sector for 25 years, from 1980 to 2010.
The independent variables taken into consideration by the authors, in order to understand which factor affect impaired loans, were: real GDP per capita, Interest rate and Total Loans.
The hypothesis formulated in the paper states that there is a significant relationship between these variables and the NPLs rate and are studied with an ordinary least square method and Pearson's correlation analysis.
The econometric analysis highlights that we have a strong correlation between the NPL and the other independent variables.
In particular, real GDP per capita shows the highest negative correlation, about 68% so could strongly explain the variation in NPLs, then interest rate, which also shows a negative correlation with impaired loan rate and finally total loans, that shows the lowest positive correlation, about 28%, with the dependent variable.
The simple regression shows that the model used is statistically sound and all the single variables has statistical significance but doesn't provide a mathematical significance of the independent factor chosen, since all the coefficients of the variables are very small.
Concluding, we can say that the paper redacted by Saba et al. (2012) shows a connection between Macroeconomic variables and the NPLs' ratio in the us banking sector.

Additionally, the literature provides other papers which analyse the determinant factor of NPLs by taking as sample a single country or more countries belonging to the same European macro area.
Jakubik & Reininger (2013), Nir Klein (2013) and Tanasković & Janadrić (2015) studied the determinants of Non-Performing loans in CESEE countries.
Louzis, Vouldis & Metaxas (2011) had studied the relevant factor of impaired loans in the Greek banking sector.
Carlo Milani (2017) shows which variables impact on NPLs in Italy.
Finally, I considered the paper written by Abid, Ouertani & Zouari-Ghorbel (2013) whom considered as sample the Tunisian banking system.
Starting from the CESEE countries, the document redacted by Jakubik et al. (2013) analyse the NPL ratio as an indicator of credit risk assessment, more precisely as an indicator of probability of default of sample's banking sector.
The nations taken in the sample are Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Russia, Slovakia and Ukraine.
The independent variables taken into account from the authors has Macroeconomic nature.

The determinants chosen by the authors are: the real GDP growth; the Chicago Board Options Exchange Market Volatility Index (VIX) as a degree of implied volatility, so as proxies for risk attitude and for financial and economic development in CESEE countries; the domestic bank credit to private sector, both private and non-financial corporations, is considered with the credit aggregate relative to GDP ratio. Is expected that this ratio has a negative impact on NPLs on short term, due to the credit growth, but in long term, the expected correlation is positive, due to the effect of credit cycle, often combined with low lending monitoring, which cause an increase in NPL level; the exchange rate, since several loans are expressed in foreign currency and this lead to an indirect credit risk due to probability of depreciation; the aggregate demand components, both domestic demand and aggregate demand.

For the econometric analysis, the authors have chosen a dynamic panel data, up to 6 lags, estimated with GMM estimator and also computed a panel data with fixed effect in order to understand the correlation between the variables.

After their evaluation, the writers find out a negative correlation between the domestic aggregate demand components and the NPL ratio, means that when export and domestic demand raise, this tend to reduce the defaulting debtor.

Also empirical results show that stock price influences NPL, in particular first lag directly influence negatively the impaired loans ratio.

Moreover, the research found negative correlation with Real GDP and Private sector credit to GDP, on the first lag, as expected by the literature, but found a positive correlation between the NPL level in CESEE countries and the Private sector credit to GDP ratio at sixth lag, meaning that the credit cycle, on medium term, leads to an increase in NPL caused by a reduction on credit monitoring, as explained by the literature.

CESEE countries were studied also by Klein (2013), who found also bank specific variables, with Macroeconomic variables, affecting NPL ratio in those countries.

The sample is composed by 16 CESEE countries and include the years between 1998 and 2011.

The variables studied by the author were, at Macroeconomic level: inflation, exchange rate against Euro and change in unemployment rate as country specific variables; Euro zone's GDP growth and again VIX, as a measure of implied volatility used to capture the global risk aversion, as global variables; Equity-to-Asset ratio, used to highlight if there are moral hazard problems, Return-On-Equity, Loan-To-Asset ratio and Loans growth rate as bank specific variables.

The econometric method used was a dynamic panel data with both fixed effect method, system and difference GMM estimator.
The paper also analyses the feedback effects of banking system in real economy, in particular focuses the study on the linkages between NPL and banking system, credit to GDP ratio, GDP growth, Unemployment and inflation. This examination was computed with a panel VAR methodology.
The results highlighted by the study are: considering the first study, authors find out that a higher equity to asset ratio leads to a reduction on NPLs, confirming the moral hazard hypothesis, also an increase in ROE leads to a reduction on impaired loans level.
Concluding with bank specific variables, the econometric analysis figures out that loan to asset ratio and loans growth rate leads to an increase in non-performing loans level.
However, the result shows a small impact of these variables on the NPLs level, despite of the macroeconomic variables. Indeed, as result suggests, the other type of variable has a strong relevance on bank's asset quality, in particular unemployment, inflation rate lagged for one period, the exchange rate and VIX (implied volatility index) shows a positive link with the dependent variable, means that those factor contributes to an increase in NPL for these countries.
Only real GDP growth reduces the amount of deteriorated asset held by the banks.

Regarding the other analysis, about the feedback on real economy, the result underline that an increase of one percentage point in credit-to-GDP ratio and real GDP leads to a decline in NPLs stock. In contrary if inflation raise by one percentage point, also the impaired loans increases in next year.
Instead if NPLs increases, credit, inflation and GDP growth decline and unemployment will raise.

The last paper which analyse the determinants of NPL in CESEE countries is the one written by Tanasković et al (2014), which studies what has determined the growth of NPL ratio.
The sample taken in the study include specific CEEC an SEE countries and considers a time window from 2006 to 2013.

The determinants factor taken as independent variables by the authors has both Macroeconomic and financial nature, in particular: level of GDP, ratio of foreign currency loans to total loans ratio, exchange rate level, average lending rate for new loans and inflation as country specific variables; strength of auditing and reporting, financial market development and soundness of

banking system as institutional factors that can explain the quality of legal framework in controlling the behaviour of banks.
The econometric analysis used is a static panel data implemented with a fixed effect estimation.
The statistically significant outcomes are, at macroeconomic level, GDP and average lending rate, which are negatively correlated with the NPL ratio and foreign currency loan ratio and level of exchange rate are positively linked with impaired loans level, means that those country specific variables contribute to increase the deteriorated asset held by banks.
Considering the other set of variables, only the developed financial market variables is statistically significant and negatively linked to NPLs stock, so if the financial markets are more developed past due loans are less.

Further analyses are based on single country of European Union.
Louzis et al. (2011) provide an interesting study on the determinants of NPLs in Greece, one of the nation most afflicted by this problem.
The author examines the main factor of impaired loans differentiating them by categories: consumer loans, business loans and mortgages.
The variables taken in consideration have both Macro and Bank-specific nature, in particular can be found: sovereign debt, expressed as debt over nominal GDP; unemployment rate, lending rate and real GDP growth rate as country specific variable.
As Bank specific variables the authors selected: inefficiency ratio, expressed as operating expenses over operating income, as a measure of bad management, expected to be positive linked to NPLs, and is also used to control the skimping hypothesis, means that if cost efficiency is high, could lead to an increase in NPL because loans are less monitored; Moral hazard hypothesis, computed with solvency ratio as variable; diversification hypothesis, calculated with the size of the bank (asset over total sample asset) and with non-interest income ratio, so noninterest income over total income; too big to fail hypothesis, calculated with the leverage ratio conditioned to size of bank, the logic of this variable is based on the fact that big bank takes higher risk and so the amount of NPL should be higher; ROE, used again to capture the bad management of the bank; three dummy variables used in order to capture the ownership concentration variable.
Last hypothesis considers again ROE but in pro-cyclical credit policy, so hypothesis that performance is positively correlated with future amount of NPL, reflects bank's liberal credit policy.
The econometric methodology used in this paper is a dynamic panel data implemented with a GMM estimator in which is introduced also another variable, the lagged NPL amount.

The result shows a positive correlation with unemployment, lending rate and debt as stated in the literature and a negative correlation with real GDP, so when economy grows NPL tends to reduce.
More interesting are the outcomes of bank specific variables, in particular the analysis confirms the hypothesis of bad management, since when inefficiency rise also NPL level increase.
The study found also the presence of too big to fail hypothesis on mortgage and business loans, so a significance for leverage rate variable. Is fund also a confirm of moral hazard hypothesis through the significance of solvency ratio.
In addition, the study reveals that the quantitative effect of NPL factors depend on category of loans, indeed some macro and bank specific variables are more significance for some category of loans: consumer loans are more affected by changes in lending rate, business loans to real GDP growth while mortgages are less affected by macroeconomic variables.

Another European nation that has a huge amount of NPLs is Italy and was studied by Milani (2017) who analyse the main factor of deteriorated asset during macroeconomic and financial turbulence.
Milani, in this research, found that, for Italian banking system, the macroeconomic variable, during the stress period, so in the years from 2006 to 2015 of all Italian banks that has at least €50 million of total asset, has low effect on NPLs while bank specific determinants appears to be more significant for Italian sample, in contrary with CESEE studies.
The independent variables adopted by the author are: annual growth of real GDP, debt to nominal GDP ratio as Italian specific variables.
As bank specific variables, the factor analysed are: net interest income over total asset as a variable of bank-based interest rate; solvency ratio, expressed as equity to total asset, as a measure of bank's ability to repay long term debts; inefficiency ratio, computed as operating expenses over operating income; ROE, as measure of bank profitability; non-interest income over interest income as bank's income diversification variable; size, computed as ratio between total asset to sample total asset.
The researcher also controls for some dummies variables, such as: the headquarters of Italian banks, juridical form of banks, mutual or cooperatives; annual rate of loan's growth; loans to employee ratio; total liabilities over total asset ratio.
The econometric model estimation chosen in this paper is a system GMM estimator based on a dynamic panel data and the hypothesis formulated are: sovereign debt hypothesis, not rejected if debt coefficient is positive; bad management hypothesis, valid if inefficiency coefficient is positive and roe coefficient negative;

skimping hypothesis, not rejected If inefficiency coefficient is negative; moral hazard hypothesis, valid if solvency ratio coefficient is negative; diversification hypothesis,, not rejected if size and noninterest income coefficients has opposite signs; too-big-to-fail hypothesis, valid if derivative of variation of NPL with respect to leverage ratio is positive for high size; procyclical credit policy hypothesis, not rejected if ROE and loan coefficients are positive; relationship lending hypothesis, valid if loan over employees ratio coefficient is positive; cooperative banks hypothesis, confirmed if dummy of bank's juridical nature is negative.
The results shows that the sovereign debt hypothesis, bad management hypothesis, moral hazard hypothesis, diversification hypothesis, cooperative banks hypothesis, too-big-to-fail hypothesis and relationship lending hypothesis are not rejected since the coefficients of the variables has the correct sign and is found on the model a statistical significance of those variables, which are: debt, solvency ratio, roe, dummy of juridical bank's nature, noninterest income ratio, loan over employees ratio and leverage ratio.

Milani research has found some of the relevant factors that affects Italian NPL, this could have also policy implication since found that macroeconomics variable has low impact while a stronger bank supervision could solve some issue relative to the management of those impaired loans.

The paper redacted by Abid et al. (2014) which investigate the determinants of households NPL's in Tunisian banking system.
The sample cover 10 years, from 2003 to 2012, and 16 Tunisian banks.
The variables selected by the authors has both Macroeconomic and Bank specific nature, in specific: GDP growth, inflation rate and real lending rate as country specific variables.

The bank specific variables were chosen according to investigate some relevant hypothesis, in particular can be found in the research: Bad management hypothesis, investigated with inefficiency ratio, computed as ratio between operating expenses and operating income expected to have positive coefficient and with performance ratio as ROE, expected negative coefficient; skimping hypothesis, observed with inefficiency ratio again, but here is expected to have negative coefficient; moral hazard hypothesis, analysed with solvency ratio, so owned capital over total asset, expected to have negative coefficient;

diversification hypothesis, verified with size variable, so ratio between bank asset and sum of total bank's asset of the sample, which coefficient is expected to be negative; procyclical credit policy, not rejected if ROE's coefficient is positive.
The econometric analysis used by the writers is a GMM estimator based on a dynamic panel data, in which they insert also lagged value of NPL's for one year as independent variable.
The results show that, regarding macroeconomic variable, lagged NPL is negatively linked with current NPLs, with also GDP growth, while lagged inflation and lagged real interest rate are both positively correlated with non-performing loans; all of these variables are statistically significant.
The outcomes of the analysis also confirm: the bad management hypothesis, since ROE has negative coefficient and inefficiency ratio positive coefficient, both are statistically significant; moral hazard hypothesis, since solvency ratio lagged for two period has negative coefficient and is statistically significant.
So the researchers find out that both Macroeconomic variables and bank specific variables has an impact on households non-performing loans in Tunisian banking system.

An interesting research which studies the determinants of Non-Performing Loans, mostly Bank-Specific Variables, is the one redacted by Amit Gosh (2015), who investigates which factors affect the NPLs level across 50 US states, from 1984 to 2013.
The hypothesis to test are similar with the other existing literature.
The author, accruing to the results of his analysis, confirmed the positive relationship with NPLs level and loan-to-asset ratio, confirming the hypothesis of greater risk with positive loans growth rate; highlight also a positive correlation between loan loss provision-to-total asset ratio, confirming the hypothesis under which, if a bank has poor credit quality is more encouraged to take riskier positions; furthermore, positive correlation is found between non-interest income-to-total assets, underlying that bank whom diversify their businesses tend to have higher NPL level in their balance sheets; confirms the hypothesis of bad management, finding that a decrease in profitability lead to an increase in impaired assets; concerning the macroeconomic variables, the analysis implemented by Gosh underlines that Real GDP growth, inflation rate and housing price index have a negative correlation with the NPLs level. In the other hand, an increase in the unemployment rate, in the US states, leads to an increase in NPLs, since the individual, who faces job troubles due to the rise in unemployment, have higher problems to meet their debt obligations.

A further analysis of the determinants of Non-Performing Loans was conducted by Rajiv Ranjan and Sarat Chandra Dhal, whom investigate the factor that influences NPL ratio in the Indian banking sector.

The results are estimated with a panel regression model estimated subject to cross-section specific fixed coefficients, in order to capture the effect of the differential social and geo-political environment confronting banks' operations.

The hypothesis tested and confirmed by these two authors are the bank size hypothesis, where found a negative correlation between the ratio between bank's assets to total asset of all public sector banks and the Gross NPL; furthermore, was found a negative correlation between the maturity terms of the credit and gross NPL, in particular, if the maturity of loans rises the gross level of impaired loans will decrease; other two negative correlation was found, in particular with the credit-deposit ratio relative to that industry and the gross NPL level, implying that borrowers attach considerable importance to the credit oriented banks, and with the expectation of higher growth of macroeconomic and business conditions and gross NPL, suggesting that an increased macroeconomic condition lead to a decrease of borrower's financial distress and so higher capability of debt repayment.

In the other hand, the researchers find a positive correlation between the current cost and past cost condition and gross NPL, meaning that if the interest rate is expected to increase this induces to a change in cost conditions which leads to an increase of bad loans held by the banks taken into sample.

The authors find out a further interesting result, in contrast with most of the literature, which consists in a positive correlation with the lagged GDP growth rate and the NPL level. This relation is justified by the fact that the banks took higher risk, according to the improved national economic situation.

Final summary:

"Household debt sustainability: what explains household non-performing loans? An empirical analysis" written by Rinaldi & Sanchis-Arellano (2006) find out that, when ratio of indebtedness of the country, inflation and real lending ratio increases, also non-performing loans held by the banks increases, instead household wealth and the amount of collateralized loans tend to decrease the impaired loans held.

In the paper "Micro and macro determinants of non-performing loans" written by Messai & Jouini (2013) was found that NPL's has negative correlation with ROA and GDP growth and

a positive correlation with unemployment rate, real lending rate and loan loss reserve ratio.

In the research "Determinants of Non-Performing Loans: The Case of Eurozone" redacted by Makri et al. (2013) was found that Impaired loans were determined positively by lagged NPL, unemployment rate and public debt, in contrary were negatively correlated with bank capital and reserves to total asset, ROE and GDP growth.

Dimitros et al. (2016) on their research "Determinants of Non-performing loans - evidences from Euro-area countries" find out that NPL's are positively correlated by lagged NPL, unemployment rate, public debt, tax-to-income ratio and loan-to-deposit ratio. On the other way the researchers find out a negative correlation with ROE, ROA, GDP growth and business cycle.

In the paper written by Saba et al. (2012) "Determinants of non-performing loans: case of US banking sector" researchers find out that doubtful loans have negative correlation with real GDP per capita and interest rate, in contrary has positive correlation with amount of total loans.

Jakubik et al. (2013) redacted "determinants of Non-performing loans in Central, Eastern and South-eastern Europe" and find out that impaired loans are negatively correlated with domestic aggregate demand, stock price, real GDP, private sector credit at its first lag and are positively correlated with sixth lag of private sector credit.

The author Klein (2013) in his research "Non-Performing loans in CESEE: determinants and impact on macroeconomic performance" found out that an increase in ROE, equity to asset ratio and GDP growth leads to a reduction of non-performing loans. In contrary an increase in loan to asset ratio, loans growth rate, unemployment, inflation lagged for one year, implied volatility index and exchange rate leads to an increase in NPL's held by banks.

The research "Macroeconomic and institutional determinants of non-preforming loans" written by Tanasković et al (2014) highlights that an increase GDP, average lending rate and developed markets leads to a reduction of non-performing loans, instead foreign currency loans ratio and exchange rate ratio are positively correlated with non-performing loans.

Louzis et al. (2011) in "Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios"

discovered that non-performing loans has a positive correlation with unemployment, lending rate, debt, inefficiency ratio, leverage ratio and size. On the other hand, researchers found that GDP growth and solvency ratio has a negative correlation with non-performing loans.

The paper "What factors affect non-performing loans during macroeconomic and financial turbulence? Evidence from Italy" written by Milani (2017) highlights that leverage ratio, debt, inefficiency ratio and loans-over-employees ratio has a positive correlation while solvency ratio and dummy for juridical banks has negative correlation.

In "Macroeconomic and Bank-Specific Determinants of Household's Non-Performing Loans in Tunisia: A Dynamic Panel Data" written by Abid et al. (2014) found out a positive correlation between lagged inflation and lagged interest rate as macroeconomic variables and with inefficiency ratio as bank-specific factor.
In the other hand highlights a negative correlation with GDP growth, as macroeconomic variable, and with ROE and solvency ratio as microeconomic variables.

In "Non-Performing Loans and terms of credit of public sector banks in India: An Empirical Assessment" written by Rajiv Ranjan and Sarat Chandra Dhal, the authors found a positive correlation between NPL level and change in cost terms of credit and lagged GDP growth rate.
In the other hand, found a negative relation between bank size, maturity terms of credit, measure of credit orientation and macroeconomic and business improvement.

In "Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states", written by Amit Gosh, was found several determinants of NPL.
In particular, the author's analysis reports a positive correlation between NPL level and Loan-to-asset ratio, loan loss provisions and non-interest income-to-total income as bank-specific variable and unemployment rate as regional variable. In the other hand, in the research is found a negative correlation between the NPL level and ROA, as bank-specific variable, and with Real GDP growth rate, Real personal income growth, Inflation rate and house price index as regional variables.

Chapter four: methodology description

The methodology chosen for my personal econometric analysis is a GMM estimator, based on a dynamic panel of data, since there is, as independent variable, the lagged value of the dependent variable.
In order to understand the methodology chosen, in this chapter I wanted to provide a brief description on how the chosen model works, starting with the definition of panel data to the description of the GMM estimator.

4.1 Panel data

The word panel means a board of data. The data, in this case, are two-dimensional, means that the variable X has two indexes: one dimension concerns the individuals and the other one regards the time, such as:

$$\begin{bmatrix} X_{11} & \dots & X_{1T} \\ \vdots & X_{it} & \vdots \\ X_{N1} & \dots & X_{NT} \end{bmatrix}$$

The two dimensions may have different length and according to this has a different definition.
A panel of data is said time-series panel if the time index is greater than the individual index and the matrix representation is:

$$\begin{bmatrix} X_{11} & \dots & \dots & \dots & X_{1T} \\ \vdots & \dots & X_{it} & \dots & \vdots \\ X_{N1} & \dots & \dots & \dots & X_{NT} \end{bmatrix}$$

Here $T>I$ and this type of data is often used in macroeconomics analysis.
In the other hand, if the individual index is greater than the time index, the panel is said to be a cross-section panel, usually encountered in microeconomics analysis.

The matrix form, in this case, is:

$$\begin{bmatrix} X_{11} & \dots & X_{1T} \\ \vdots & \vdots & \vdots \\ \vdots & X_{it} & \vdots \\ \vdots & \vdots & \vdots \\ X_{N1} & \dots & X_{NT} \end{bmatrix}$$

Panel's data has to not be confused with other types of data, which can be quite similar, such as:

- Longitudinal data which looks like panel but time index is not common for the individuals chosen;
- Pseudo-panel where individuals may change in different time points, so across time;
- Unbalanced panel where time differs among individuals, so the data have no longer a matrix shape.

The two different dimension of panel data have different quality and behaviour.
In particular, the time dimension act as a time series, so has properties such as natural ordering, systematic dependence over time, asymptotic dependence on stationarity, ergodicity etc.

In the other hand, individuals dimension behaves like a cross-section, so in these type of data there is not natural order, it can be found dependence across sections (second generation) and asymptotic independence (first generation).
The advantages of treating panels are that, this type of data, are more informative than a simple aggregate of time series, because they take into consideration also the individual histories through time.
Panel data, also, are more informative than cross-section data since they reflect dynamic and granger causality, so the statistical determination of a causality across variables.

The main models to estimate the panels data are the:

- Fixed effect: considers an individual effect μ_i, which is assumed to be an independent variable, that is called the fixed effect and its condition is $\sum_{i=1}^{N} \mu_i = 0$ which is not the error term, that has zero mean and variance equal to Ev = 0 and var$v$ = σ^2_v

- Random effect: is used when the sample is large and the unobservable effect is no longer an incidental variable but became a random variable.
- Two-ways panel: in this estimator are considered both an individual specific unobserved constant and a time-specific constant.

4.2 Dynamic Panel data

The dynamic panel data model differs from the panel data because contains, in the regression function, at least one lagged variable.
This data model is the one I have used in my master thesis because my analysis comprises also lagged variables, useful to understand if choices or action taken in the past has an effect on the current dependent variable.

A dynamic panel data function is given by:

$$y_{i,t} = \gamma y_{i,t-1} + \beta' x_{it} + \alpha_i^* + \varepsilon_{i,t}$$

Where i=1,…, N and t=1,…, T. $\alpha_i^* \; and \; \lambda_t$ are the individual and time specific unobserved variables.
The error term $\varepsilon_{i.t}$ is idiosyncratic and behaves as $E(\varepsilon_{it}) = 0$ with $E(\varepsilon_{it}\varepsilon_{js}) = \sigma_\varepsilon^2$ if $j = i$ and $t = s$ and $E(\varepsilon_{it}\varepsilon_{js}) = 0$ otherwise.

In these model fixed effect and random effect are no longer feasible since the model is not strictly exogenous, due to the lagged explanatory variables, fixed-effect assumption, hence, are violated, and the model depends on the assumption of initial observations, so random effect models could be distorted.

The models used to estimate this type of data are the instrumental variables (IV) approach and the Generalized Method of Moments (GMM), since produce consistent parameters estimates for a finite number of periods T and cross-sectional data N.

In order to study and analyse my data I have chosen the GMM model since is the most precise and consistent given the characteristics of my dataset and also this model provide

asymptotically efficient inference employing a relative small number of statistical observation.

4.3 GMM estimator

The GMM estimator is widely used when the autoregressive parameters in dynamic panel data models is moderately large and the time series observations are relatively small.
The GMM estimator works on first differencing, in order to remove the individual effect and the time-invariant variables.
The definition of this estimator states that "the standard method of moment estimator consists of solving the unknown parameter vector θ by equating the theoretical moments with empirical counterparties or estimates".

The Generalized Method of Moments approach is based on a dynamic panel data model which equation is expressed as:

$$y_{i,t} = \gamma y_{i,t-1} + \beta' x_{it} + \rho' \omega_i + \alpha_i + \varepsilon_{i,t}$$

Where:

- α_i are the unobserved individual effects;
- x_{it} is a vector of K_1 time-varying explanatory variable;
- x_{it} is a vector K_2 time-invariant variables;

The model's assumptions regards the properties of the error term $v_{it} = \varepsilon_{it} + \alpha_i$:

- The expected value is equal to zero$E(\varepsilon_{it}) = 0$, $E(\alpha_i) = 0$;
- $E(\varepsilon_{it}\varepsilon_{js}) = 0$ if $j=i$ and $t=s$, 0 otherwise, means that expected correlation between errors through time an individual is equal to the variance, when computed on same individual and point in time or zero;
- $E(\alpha_i\alpha_j) = 0$ if $j=i$ or zero otherwise, means that correlation between individual effect is equal to the variance or zero;
- $E(\alpha_i x_{it}) = 0, E(\alpha_i \omega_i) = 0$ this assumption grants the exogeneity of the time invariant variables ω_i;

As said before, the GMM estimator is based on a model in first differences, used for get rid of the individual effects and the time invariant variables.
The regression function is expressed as:

$$(y_{it} - y_{i,t-1}) = \gamma(y_{i,t-1} - y_{i,t-2}) + \beta'(x_{it} - x_{i,t-1}) + \varepsilon_{it} - \varepsilon_{i,t-1}$$

The validity of the instruments for the dependent variable is based only on the first lag of the dependent variable itself and not for the further lags.
The lagged variables, in order to be valid instruments, have to satisfy the following properties:

- Exogeneity property: $E\left(y_{i,t-2-j}(\varepsilon_{it} - \varepsilon_{i,t-1})\right) = 0$;
- Relevance property: $E\left(y_{i,t-2-j}(y_{i,t-1} - y_{i,t-2})\right) \neq 0$;

In order to estimate $\theta = (\beta, \gamma, \rho, \sigma_\alpha^2, \sigma_\varepsilon^2)$, the estimator uses a moment condition, expressed as $E\left(y_{i,t-2-j}(\varepsilon_{it} - \varepsilon_{i,t-1})\right) = 0$ for $j = 0,1,...,m$ for the moment $m+1$.
The moment condition provides the existence of a vector of parameters $\theta_0 = (\beta_0', \gamma_0, \rho_0', \sigma_{\alpha 0}^2, \sigma_{\varepsilon 0}^2)'$ such that $E\left(y_{i,t-2-j} \times (\Delta y_{it} - \gamma_0 \Delta y_{i,t-1} - \beta_0' \Delta x_{it})\right) = 0$.

GMM estimator requires also two further properties on the explanatory variable which allows the validity of the instruments, and those are:

- Strictly exogeneity of the explanatory variables, expressed as $E(x_{it}' \varepsilon_{is}) = 0 \; \forall (t, s)$. so the orthogonality conditions, so the conditions under which the variables are uncorrelated, is expressed by $E(q_{it} \Delta \varepsilon_{it}) = 0$ with $t = 2, ..., T$ and with $q_{it} = (y_{i0}, y_{i1}, \ldots, y_{i,t-2}, x_i')'$;

- Pre-determination conditions for the time-varying explanatory variables, such as $E(x_{it}' \varepsilon_{is}) = 0 \; if \; t \leq s$;

The system can be just identified if the number r of moments is equal to the dimension a of θ. In this case, generally, is possible to identify the estimation of θ uniquely.

If, in the other case, the system is over-identified, so if the number of moments is greater than the dimension of θ, and the non-linear equation $\widehat{m}(y;\hat{v}) = 0$ has no solutions. In this case GMM estimator minimize the distance measure of $\widehat{m}(y;\theta)'$ over-identified in order to find the estimate of the unknown parameters.

GMM minimize the following criteria:

$$\hat{\theta} = argmin\ q\ (y,\theta) = argmin\ \widehat{m}(y;\theta)'^{S^{-1}}\widehat{m}(y;\theta)$$

Where S^{-1} is the optimal weighting matrix.
The optimal weighting matrix is defined as, in general case, the inverse of the long-run variance covariance matrix of $m\ (y_t;\theta_0)$, defined as:

$$S = \sum_{j=-\infty}^{\infty} E(m(y_t;\theta_0)\ m(y_{t-j};\theta_0)')$$

in order to estimate the optimal matrix, the unknot parameter θ could be replaced by the one estimated with the GMM estimation $\hat{\theta}$.

However, this solution may arise problems, for the estimator, to being no positive definite, or a circularity issue, since the estimated parameter for computing the optimal weighting matrix is the same both for time t and t-1.

The solution for the two problems are two implementations for the estimator, the first is the Non-parametric kernel estimation, for the first problem, and the second is the two-steps GMM estimation, for solving the second issue of circularity, in which at first is computed a consistent but not efficient estimator using an identity weighting matrix; the second steps consists in computing the estimator for the optimal weighting matrix.

$$\widehat{S_1} = \widehat{\Gamma_0} + \sum_{j=1}^{q} K\left(\frac{j}{q+1}\right)(\widehat{\Gamma_j} + \widehat{\Gamma_j'})$$

After these two steps is possible to compute an efficient GMM estimator without the circularity issue.

$$\widehat{\theta_1} = \arg\min \widehat{m}(y_t;\theta)' \widehat{S_1^{-1}}\, \widehat{m}(y;\theta)$$

After the explanation of GMM estimator is useful to understand also how this estimation model is applied to the dynamic panel estimation, in order t understand how the analysis of mine thesis were conducted.
The main proposals for the application of the GMM estimator were given by these authors: Arellano and Bonds (1991), Arellano & Bover (1995), Ahn and Schmidt (1995), Blundell and Bond (2000).

These application are very important for calculate the unknown parameter to estimate.
The first application was studied by Arellano & Bond in 1991.
The dynamic panel data model has to be considered in first difference such as:

$$\Delta y_i = \Delta y_{i,-1}\gamma + \Delta X_i\beta + \Delta\varepsilon_i \text{ with } i = 1, ..., n$$

And the parameter to estimate is $\theta = (\gamma, \beta')'$, and, in order to found it, are used moments conditions, if independent variables are strictly exogenous, such as:

$$E\,(W_i\Delta\varepsilon_i) = E\left(W_i\times\left(\Delta y_i - \Delta y_{i,-1}\gamma - \Delta X_i\beta\right)\right) = 0_r.$$

The Arellano & Bond estimator want to minimize the difference between the moments used in the estimator and zero.
The estimator used for identify the unknown parameter is the following:

$$\hat{\theta} = \arg\min\left(\frac{1}{n}\sum_{i=1}^{n}\Delta\varepsilon_i' W_i'\right) S^{-1}\left(\frac{1}{n}\sum_{i=1}^{n}\Delta\varepsilon_i W_i\right)$$

With S the optimal weighting matrix identified as

$$S = E\left(\frac{1}{n^2}\sum_{i=1}^{n} W_i\Delta\varepsilon_i\Delta\varepsilon_i' W_i'\right)$$

under the assumption of non-autocorrelation between the weights and the error term.
The other interesting estimator, most accurate and consistent, is the one implemented by Blundell and Bond in 2000 called system GMM estimator.

This model was invented by the two authors to solve the problem of weak instrument. The method considers the equation both in level and in first differences, such as:

$$E\left(y_{it,-s}\Delta\varepsilon_{it}\right) = 0 \quad E\left(x_{i,t-s}\Delta\varepsilon_{it}\right) = 0 \text{ difference equation}$$

And the moments explored are the following ones:

$$E\left(\Delta y_{it,-s}(\alpha_i^* + \varepsilon_{it})\right) = 0 \;\; E\left(\Delta x_{i,t-s}(\alpha_i^* + \varepsilon_{it})\right) = 0 \text{ level equation}$$

In GMM estimator the additional moments were implemented in order to solve the weak instrument problem, so for increase the asymptotic efficiency of the estimator.

This section is fundamental for understanding the analysis provided in this master thesis since the models over descript are the ones used to estimates the macro and micro determinants of Non-Performing Loans.

Chapter five: Data specification and Results

The research implemented in my master thesis regards the determinant of Non-Performing Loans in a panel of 16 European countries.
In the recent years several authors try to identify which were the main factors that affect impaired loans, since this type of assets grew rapidly and notably after the 2008's financial crisis.

In Europe this increase it was caused not only by the financial crisis, but also with the sovereign crisis of 2010-2011, were some of EU countries, especially the southern, faces serious troubles with their sovereign debt level and debt/GDP ratio.
This raise in financial instability of the governments caused a raise in NPL's ratio, since the internal economic environment has deteriorated and this lead to the insolvency of several borrowers and thus the increase of bad loans.
The intention of the analysis realized in mine thesis is to understand which are the main factor that affects the gross amount of Non-Performing Loans, which has a Macroeconomic and a Bank-specific nature.

In order to implement and structure my analysis, I have proceeded with the following steps:

- Decide the macroeconomics and bank-specific variables to set as independent in the econometric analysis;
- Decide the panel of bank and countries to include in the econometric analysis;
- Decide how to split the data in order to analyse and compare the different results;
- Collect the data to include in the analysis both from Eikon DataStream and from the aggregate balance sheet and income statement of some credit institutions form their annual reports, in order to have also the missing information not included in Thomson Reuters dataset;
- Create the dataset with Excel in order to have a summary of all data;
- Split the data according to the sub-sample decided previously;
- Implement the econometric analysis, the estimation of dynamic panel data with GMM estimator, in R software;
- Analyse the result provided by the estimation;
- Redact the conclusion according to my results and comparing them with the literature;

In order to decide which variables take into consideration for the econometric analysis I get inspired from the other research, which treat the same arguments, and I have tried to understand which factor could drive this typology of assets.
The main factors I have choose for the analysis are:

- Unemployment rate;
- Gross Domestic Product (GDP) rate;
- Return on Equity (ROE);
- Loans growth rate;
- Tier 1 capital ratio;
- NPL over Loans ratio;

Both these macroeconomic and microeconomic variables will be discussed in detail later on this chapter.

5.1 Data specification

Regarding the sample chosen, I have decided to focus my analysis in a panel of European banks. In particular, the sample is divided into two areas of European Union; the first concerns the southern Europe and the other some countries of West Europe.
For each country I have selected from two to four of the main banks which has their legal site in the specific countries and listed in the national stock exchange.
As main bank is intended the bigger banks, in terms of assets held, of the specific European nation.

In the table below I will report, in detail, the selected banks:

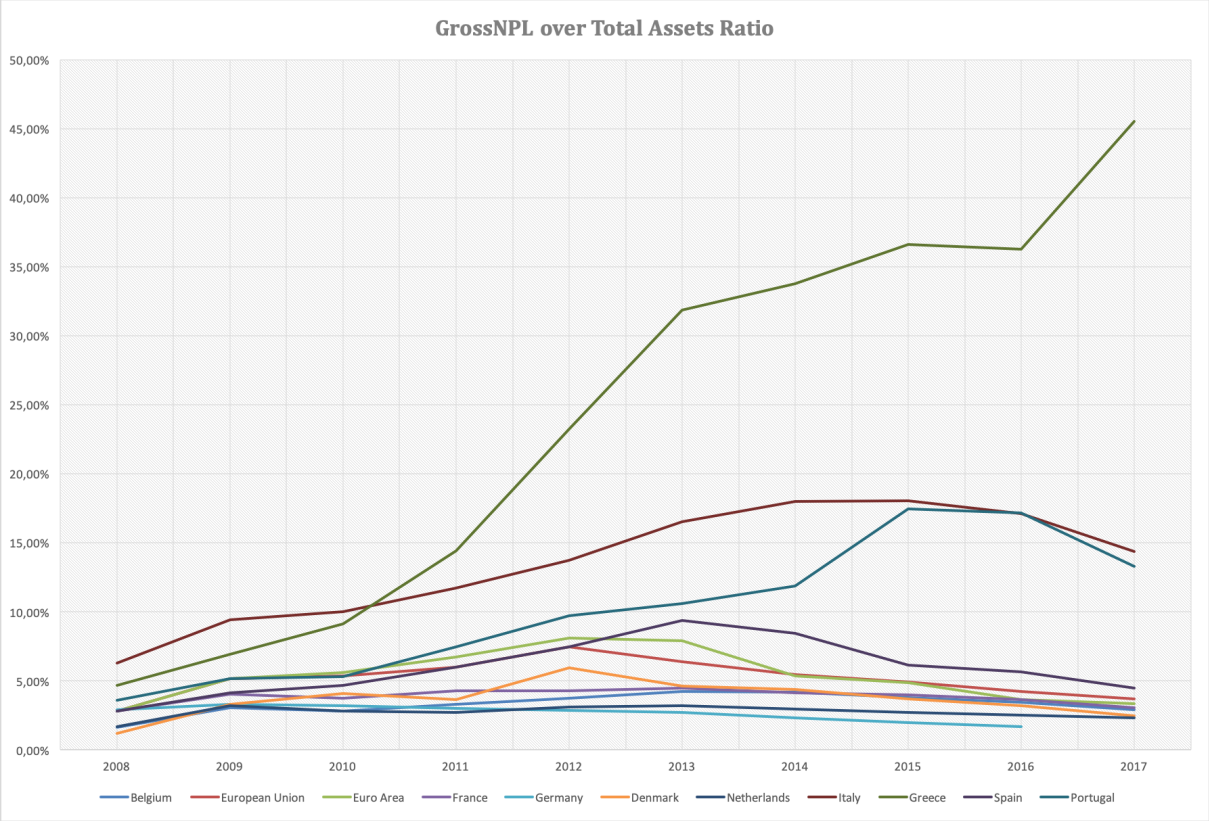
Bank	Nation	Region
Intesa San Paolo	Italy	South Europe
Unicredit	Italy	South Europe
Mediolanum	Italy	South Europe
UBI Bank	Italy	South Europe
Banco BPM	Italy	South Europe
Montepio	Portugal	South Europe
Banco Commercial de Portugal	Portugal	South Europe
Banco BPI	Portugal	South Europe
Eurobank Ergasias	Greece	South Europe
National Bank of Greece	Greece	South Europe
Piraeus Bank	Greece	South Europe

Attica Bank	Greece	South Europe
Banco de Sabadell	Spain	South Europe
Caixa Bank	Spain	South Europe
BBVA	Spain	South Europe
Banco Santander	Spain	South Europe
Deutsche Bank	Germany	West Europe
DZ Bank	Germany	West Europe
Commerzbank	Germany	West Europe
KFW Bank	Germany	West Europe
Credit Agricole	France	West Europe
BNP Paribas	France	West Europe
Societè General	France	West Europe
BPCE Group	France	West Europe
ING Group	Netherland	West Europe
ABN Amro	Netherland	West Europe
Rabobank	Netherland	West Europe
Credit Europe	Netherland	West Europe
KBC Group	Belgium	West Europe
Dexia	Belgium	West Europe
Jyske Bank	Denmark	West Europe
Danske	Denmark	West Europe

Table 5.1

Is interesting also to understand how non-performing loan ratio evolves through the years in these countries selected.

The following graph illustrate the evolution of gross NPL over total asset ratio, from 2008 to 2017, for every of the 9 countries chosen for the analysis.
Is interesting to see which is the trend of the ratio and which countries were mostly affected by this burden, before proceed with the econometric analysis.
The graph is built with the data provided by the dataset implemented by World Bank Open Data.



Graph 5.1[10]

As we can see the most troubled nation are the ones situated in the south of Europe, in particular Greece, Italy, Portugal and Spain.
NPL ratio of these countries is higher, for almost all the time, with respect to the one reported for the European Union countries and also for the one identified in the Euro zone countries.
This effect could be amenable to the sovereign debt crisis which affects European nations.
A huge increase in the ratio, indeed, is recorded during those years, as can be seen in the graph.

As confirmed in the graph, the ratio between gross NPL and total asset differs across European countries. For this reason, I have decided to split the sample in order to understand if the determinants of the variation of NPL have different nature.
The first division, thus, on the total data concern the different countries in which banks has their principal site. In the table below I will report in detail the first split:

West		South	
Bank	Country	**Bank**	Country
Deutsche Bank	Germany	**Unicredit**	Italy
DZ Bank	Germany	**Intesa San Paolo**	Italy

[10] *Source: World Bank Open Data*

Commerzbank	Germany	**Banco BPM**	Italy
KFW	Germany	**UBI bank**	Italy
Credit Agricole	France	**Mediolanum**	Italy
BCPE group	France	**Banco Santander**	Spain
Societè General	France	**BBVA**	Spain
BNP Group	France	**Caixa Bank**	Spain
ING Group	Netherland	**Banco de Sabadell**	Spain
ABN Amro	Netherland	**Attica**	Greece
Rabobank	Netherland	**Piraeus Bank**	Greece
Credit Europe	Netherland	**National Bank of Greece**	Greece
KBC Group	Belgium	**Eurobank Eragsias**	Greece
Dexia	Belgium	**Banco commercial de Portugal**	Portugal
Dankse	Denmark	**Banco BPI**	Portugal
Jyske	Denmark	**Montepio**	Portugal

Table 5.2

In order to deeply analyse the argument, I wanted to understand if different characteristic of the bank taken into analysis could affect the determinants on NPL.
In particular, I have added four additional split in my original sample, divided in half according to the median of the data, such as:

Capitalization: considering the Tier1 ratio;
Total asset: considering the total asset of each bank of the sample;
Efficiency: considering the Cost-to-Income ratio;
Time: were first split considers the years from 2008-2012, were the crises occurred, and the second from 2013-2017;

In the table below I will summarize the split for the first three categories, for the last one is not necessary since are included all the banks split by the different years.
The summary of the over mentioned sample is represented by the table below:

Efficient	Less Efficient	Capitalized	Less Capitalized	Bigger Banks	Smaller Banks
Unicredit	Banco BPM	Unicredit	Banco BPM	Unicredit	Banco BPM
Intesa San Paolo	UBI bank	Intesa San Paolo	UBI bank	Intesa san Paolo	UBI bank

Mediolanum	Deutsche Bank	Mediolanum	BNP	Deutsche Bank	Mediolanum
Banco Santander	DZ Bank	Deutsche bank	Societè General	DZ bank	Caixa Bank
BBVA	Commerzbank	DZ bank	BPCE group	Commerzbank	Banco de Sabadell
Caixa Bank	KFW	KFW	Banco Santander	KFW	Credit Europe
Banco de Sabadell	Credit Agricole	Credit Agricole	BBVA	Credit Agricole	KBC Group
ING Group	BNP	ING Group	Caixa Bank	BNP	Dexia
ABN Amro	Societè General	ABN Amro	Banco de Sabadell	Societè General	Jyske
KBC Group	BPCE Group	Rabobank	Credit Europe	BPCE Group	Attica Bank
Attica	Rabobank	KBC Group	Attica Bank	Banco Santander	Piraeus Bank
Piraeus	Credit Europe	Dexia	Piraeus Bank	BBVA	NBG
NBG	Dexia	Danske	Banco Commercial de Portugal	ING Group	Eurobank Ergasias
Eurobank Ergasias	Danske	Jyske	Banco BPI	ABN Amro	Banco commercial de Portugal
Banco Commercial de Portugal	Jyske	NBG	Montepio	Rabobank	Banco BPI
Montepio	Banco BPI	Eurobank Ergasias	Commerzbank	Danske	Montepio

Table 5.3

All the bank's data, used to implement the econometric analysis, were collected using the dataset Eikon DataStream and also were collected directly in the consolidated balance sheet or income statement, according to the nature of the variable, found on the website of the specific bank. In order to find the macroeconomics variables for each state I have consulted the Eurostat Dataset.

The complete dataset includes 32 European banks, from 9 different European member states, for a total of 320 observations for 6 variables, each one lagged for one period.

These data concern the total dataset of the analysis; for the split data, the divided sample is composed by 190 observations of 16 European banks for 6 variables.

All the dataset includes the years from 2008 to 2017 unless the last split dataset in which the sample is split for two different periods, first from 2008-2012 and second from 2013-2017.

5.2 Hypothesis Specification

The hypothesis formulated concerns the determinants of NPL previously specified ad independent variables for the analysis.
Recalling them: unemployment rate; GDP growth; ROE; Loans growth rate; Tier 1 ratio; NPL over total asset ratio.
The hypothesis to test will explain in specific how these variables will affect, theoretically and according to the literature, non-performing loans.
In particular, the macroeconomic hypotheses are:

***Unemployment rate hypothesis*:** this hypothesis will test the relationship between the change in the unemployment level. According to the theory and the literature, the unemployment rate should have a positive correlation with NPL (as reported by Messai et al (2013), Makri et al. (2013), Dimitros et al. (2016), Klein (2013), Louzis et al. (2013)) since, if people loses their job or did not find it, became more difficult to repay their obligations with the credit institution, which has to report an impairment on the loan granted to those individuals. The expected sing, thus, of the estimated coefficient is a positive sign.

Gross Domestic Product growth rate hypothesis: the hypothesis analyses the effect of a variation of non-performing loans related to the variation of the GDP growth rate. If the mentioned variable increases, means that the economic situation and environment of the specific country raises, so is expected that NPL will decrease (Messai et al. (2013), Makri et al. (2013), Dimitros et al. (2016), Klein (2013), Tanasković et al. (2014), Louzis et al. (2011), Abid et al. (2014)), given the improved situation also for individuals and for corporates.
The expected sign, thus, for the estimated coefficient is negative.

The bank-specific hypothesis implemented in my research are:

Procyclical Credit Policy: this hypothesis will test if the variation of Return on Equity will affect the variation of Non-Performing Loans. The idea under this assumption concern the management policies of the bank's management. In order to manipulate the earnings, made for

give a good signal to investors with a positive trend of net income. This policy, however, tend to postpone the problem of impaired loans and tend to increase the troubles linked to these assets which has to be faced and solved in the future (Lousiz et al. (2011), Milani (2017), Abid et al. (2014)).
The expected sign of the estimated coefficient, under this hypothesis, is positive, so an increase in ΔROE increases gross ΔNPL.

Bad Management Hypothesis: the idea under this hypothesis is linked too to the management of the banks. If banks record a negative performance could imply low management skills and also inefficient lending policies and monitoring on loans issued (Messai et al. (2013), Makri et al. (2013), Dimitros et al. (2016), Klein (2013), Abid et al. (2014)). In the other hand, if a financial institution reports positive performances means that could have good management skills and efficient lending policies.
The expected sign, thus, of the coefficient of ΔROE is negative under this assumption.

Lending Hypothesis: if, in a credit institution, is registered a positive increase in loans issued, could imply a higher probability of Non-Performing Loans issued. This assumption is justified by the fact that, a higher volume of loans issued, imply a higher cost of monitoring and analysis and, in order to maintain a good performance, those activities could be reduced (Saba et al. (2012), Klein (2013), Messai et al. (2013)). Since this process is not immediate, is the variation of loans is considerate lagged for two periods, so what happens in the previous two years.
Under this hypothesis, thus, the expected sign of the coefficient of ΔTotal Assets is positive.

Capitalization hypothesis: the idea under is hypothesis is that the banks more capitalized, according to the Tier1 ratio, could reduce the total amount of Non-Performing Loans by register a loss in the Income Statement, thanks to the higher available capital.
In particular, certain reserves included in the regulatory capital, are used for reduce the amount of impaired loans held by the bank.
The expected sign of the coefficient of the ΔT1 ratio, hence, is expected to be negative.

Bad Management II hypothesis: the idea under this hypothesis is to test the management of the bank according to their additional risk taken. In particular, the hypothesis to test concern in understanding if the additional risk implemented by the bank, computed as the variation of

the ratio between gross NPL and total loans of the bank, will increase the amount of gross impaired assets held by the bank.
According to the theory and the literature, the expected sign of the estimated coefficient of this ratio is positive.

In the table below are summarized the hypothesis to test:

Hypothesis	Variable	Sign
Unemployment rate	$\Delta Unempl\ rate = \frac{unempl\ rate_{i,t} - unempl\ rate_{i,t-1}}{unempl\ rate_{i,t}}$	Negative
GDP growth	$\Delta GDP\ gr\ rate = \frac{GDP\ gr\ rate_{it} - GDP\ gr\ rate_{i,t-1}}{GDP\ gr\ rate_{i,t-1}}$	Negative
Procyclical credit policy	$\Delta ROE = \frac{ROE_{i,t} - ROE_{i,t-1}}{ROE_{i,t-1}}$	Positive
Bad management	$\Delta ROE = \frac{ROE_{i,t} - ROE_{i,t-1}}{ROE_{i,t-1}}$	Negative
Lending	$\Delta Total\ loans = \frac{Loans_{i,t} - Loans_{i,t-1}}{Loans_{i,t-1}}$	Positive
Capitalization	$\Delta Tier\ 1\ ratio = \frac{T1\ ratio_{i,t} - T1\ ratio_{i,t-1}}{T1\ ratio_{i,t-1}}$	Negative
Bad management II	$\Delta \frac{Gross\ NPL}{Total\ Loans} = \frac{\frac{Gross\ NPL_{i,t}}{Total\ Loans_{i,t}} - \frac{Gross\ NPL_{i,t-1}}{Total\ Loans_{i,t-1}}}{\frac{Gross\ NPL_{i,t-1}}{Total\ Loans_{i,t-1}}}$	Positive

Table 5.4

5.3 Model specification

In the following chapter is included the model used for implementing the econometric analysis and the result provided by the estimator.
In order to understand which are the determinant of Non-Performing Loans in a dynamic panel data of European banks, I have realized an analysis based on the GMM estimator, explained in the previous chapter.
The regression equation to estimate is the following:

$$\Delta NPL_{i,t} = \Delta NPL_{i,t-1} + \beta_1 \Delta Unempl\ rate_{i,t-n} + \beta_2 \Delta GDP\ growth_{i,t-n} + \beta_3 \Delta ROE_{i,t-n} + \beta_4 \Delta Total\ Loans_{i,t-n} + \beta_5 \Delta T1\ ratio_{i,t-n} + \beta_6 \Delta \frac{gross\ NPL}{total\ assets_{i,t-n}}$$

Where:

$\Delta NPL_{i,t}$ is the dependent variable to estimate with the GMM estimator. The first lag of this variable is used as an instrument in the analysis;

$\beta_1 \Delta Unempl\ rate_{i,t-n}$ is the independent variable used to estimate the effect of unemployment rate on NPL, so the unemployment rate hypothesis. The effect of the variable on the dependent variable is estimated both in time *t* and lagged by one period, so in *t-1*;

$\beta_2 \Delta GDP\ growth_{i,t-n}$ is the independent variable selected for analyse the GDP rate hypothesis. Also the effect of this variable is estimated both in time *t*, taking in consideration the current year, and in *t-1*, analysing the effect of the previous year on the NPL level;

$\beta_3 \Delta ROE_{i,t-n}$ this independent variable is used in order to accept or reject the procyclical credit policy and bad management hypothesis. In order to understand the effect, the variable is lagged for two periods, in particular is considered the effect of the variable at time *t-1* and *t-2*;
$\beta_4 \Delta Total\ Loans_{i,t-n}$ is the independent variable used to analyse the lending hypothesis. The effect of the variable in NPL is estimated both in time *t-1* and *t-2*, since the lagged variable is more significant than the current lending level;

$\beta_5 \Delta T1\ ratio_{i,t-n}$ is the independent variable used to confirm or reject the capitalization hypothesis. In order to understand the effect of capitalization on NPLs, the T1 ratio effect is estimated both for the current period *t* both for the lagged period *t-1*;

$\beta_6 \Delta \frac{gross\ NPL}{total\ assets_{i,t-n}}$ is the independent variable used to analyse the bad management II hypothesis. Also this variable is taken with two lags, in particular, the time effect considered is in *t-1* and *t-2*.

5.4 Model's results

in this paragraph I will report the result of the analysis conducted for my master thesis.
The estimator used is the GMM estimator both on the form provided by Arellano & Bond (1991) and in the form provided by Blundell and Bond (1998).

Both the estimators are briefly explained in the chapter 4 of this dissertation.

The first result to show is the one provided by the estimation of the full sample, so including all the 32 banks of my dataset.

```
Number of Observations Used: 320

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-5.682791 -0.458878 -0.057419 -0.008122  0.404671  4.455573

Coefficients:
                          Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)        -0.2451200  0.1371636 -1.7871   0.07393 .
unemp_it              42.4822811 25.7320872  1.6509   0.09875 .
lag(unemp_it, 1)      -6.3889494 10.9428193 -0.5838   0.55932
GDPgr_it               5.1630826  4.6932210  1.1001   0.27128
lag(GDPgr_it, 1)      10.6642999  4.6230056  2.3068   0.02107 *
ROE_it1                0.2550809  0.1568094  1.6267   0.10380
lag(ROE_it1, 1)       -0.0807747  0.2853572 -0.2831   0.77713
Loans_it1              0.4060983  0.0531442  7.6414 2.148e-14 ***
lag(Loans_it1, 1)     -0.0033332  0.0065695 -0.5074   0.61189
T1_it                  1.9384251  9.4386810  0.2054   0.83728
lag(T1_it, 1)          0.1057371  6.3411011  0.0167   0.98670
npl_loans_it1          8.5698993  0.3386331 25.3073 < 2.2e-16 ***
lag(npl_loans_it1, 1) 10.4995661  1.3062713  8.0378 9.146e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(64) = 25.63903 (p-value = 1)
Autocorrelation test (1): normal = -2.384349 (p-value = 0.017109)
Autocorrelation test (2): normal = -0.9716489 (p-value = 0.33123)
Wald test for coefficients: chisq(13) = 97709.5 (p-value = < 2.22e-16)
```

Table 5.5

```
Number of Observations Used: 672

Residuals:
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-6.28266 -0.42922 -0.06630 -0.03173  0.35745  4.41507

Coefficients:
                          Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)        -0.0619139  0.2073598 -0.2986   0.76526
unemp_it              33.2017844 26.5095717  1.2524   0.21041
lag(unemp_it, 1)       1.5470626 16.4506406  0.0940   0.92508
GDPgr_it               7.5826376  8.9867661  0.8438   0.39881
lag(GDPgr_it, 1)      14.2175476  6.5656253  2.1655   0.03035 *
ROE_it1                0.1511639  0.4527349  0.3339   0.73846
lag(ROE_it1, 1)       -0.2212079  0.2647280 -0.8356   0.40338
Loans_it1              0.3415266  0.0741903  4.6034 4.157e-06 ***
lag(Loans_it1, 1)     -0.0012966  0.0023623 -0.5489   0.58309
T1_it                  0.3651734  8.9715755  0.0407   0.96753
lag(T1_it, 1)         -1.7421424  6.7148886 -0.2594   0.79529
npl_loans_it1          8.3877625  0.3866101 21.6957 < 2.2e-16 ***
lag(npl_loans_it1, 1)  8.7229436  1.9279414  4.5245 6.054e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(512) = 22.39139 (p-value = 1)
Autocorrelation test (1): normal = -2.167709 (p-value = 0.030181)
Autocorrelation test (2): normal = -0.236742 (p-value = 0.81286)
Wald test for coefficients: chisq(13) = 55148.13 (p-value = < 2.22e-16)
```

Table 5.6

The table above represent the estimation of the regression equation with the normal GMM estimator.

Given the significant variables of the estimation, I can confirm the unemployment rate, the lending and the bad management II hypothesis.

A statistical significance is found also in the lagged dependent NPL, in particular a negative relation. The meaning of this significance could be found on the strategies of the banks. NPL tend to decrease, indeed, if in the previous year have increased, due to the policies of write-off implemented by the credit institutions (Sorge and Virolainen, 2006).

The coefficient of the estimated parameter of the lagged GDP growth variable, is positive, in contrary of what was expected by the literature and the theory.

The motivation of the positive correlation between the GDP growth and the NPL level could be found on the behaviour of the management of the credit institutions.

Given an improved economic condition of the previous year, indeed, could be that during the previous year the lending department stared to increase the number of loans granted by implementing a riskier strategy and thus the probability of insolvency of the individual who issue a loan during a positive economic trend increases, due to the policies realized (Ranjan et al. 2013). The same reasoning holds for a period of a contraction of economic development.

The other results are the ones provided by the so called 'system GMM estimator', provided by Blundell and Bond.

The model, more precise and accurate, confirms the bad management II and the lending hypothesis and provide the same result for the GDP growth variable and the intuition for the outcome computed is the same as previously described.

The following section of the paragraph concern the analysis made on the sample split on five categories over mentioned.

The first split concerns the division between West and South countries.

This division is made in order to understand if the countries in which the banks have their legal seat influence the level of gross NPL and to understand if the factors that determine NPL level differs across these two regions.

The following table concern the estimation on the west European Countries, such as: Germany, France, Belgium, Denmark and Netherlands. The banks included in the sample are summarized in the paragraph 5.1 of this chapter.

```
Number of Observations Used: 160

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-2.884116 -0.872670 -0.058694 -0.006472  0.711606  4.593427

Coefficients:
                     Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)        -0.51939    0.42126 -1.2329 0.2175980
unemp_it               4.40001   55.73741  0.0789 0.9370789
lag(unemp_it, 1)     -40.20521   68.94792 -0.5831 0.5598095
GDPgr_it               7.41348   15.79772  0.4693 0.6388729
lag(GDPgr_it, 1)     -15.86138   17.99352 -0.8815 0.3780444
ROE_it1               -0.72769    0.46460 -1.5663 0.1172821
lag(ROE_it1, 1)       -0.71196    0.58015 -1.2272 0.2197520
Loans_it1             -0.37090    1.03260 -0.3592 0.7194547
lag(Loans_it1, 1)     -0.40294    0.70806 -0.5691 0.5693020
T1_it                -12.38185   13.24293 -0.9350 0.3497998
lag(T1_it, 1)        -39.33834   29.84080 -1.3183 0.1874120
npl_loans_it          46.98183   13.20057  3.5591 0.0003722 ***
lag(npl_loans_it, 1)  11.34218   25.89593  0.4380 0.6613929
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(64) = 2.011384 (p-value = 1)
Autocorrelation test (1): normal = -1.135536 (p-value = 0.25615)
Autocorrelation test (2): normal = -1.960089 (p-value = 0.049985)
Wald test for coefficients: chisq(13) = 127.5855 (p-value = < 2.22e-16)
```

Table 5.7

```
Number of Observations Used: 336

Residuals:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-3.9495 -0.3854  0.1146  0.1786  0.6512  3.6665

Coefficients:
                     Estimate Std. Error z-value Pr(>|z|)
lag(NPL_it, 1)        -0.56805    0.68051 -0.8347   0.4039
unemp_it            -102.60117   89.09031 -1.1517   0.2495
lag(unemp_it, 1)     -48.91966  160.29751 -0.3052   0.7602
GDPgr_it              -6.12183   24.12550 -0.2537   0.7997
lag(GDPgr_it, 1)     -13.25495   30.17948 -0.4392   0.6605
ROE_it1               -0.47860    1.06976 -0.4474   0.6546
lag(ROE_it1, 1)       -0.97562    0.77611 -1.2571   0.2087
Loans_it1              1.29608    1.68185  0.7706   0.4409
lag(Loans_it1, 1)      0.16635    2.63363  0.0632   0.9496
T1_it                 -8.19815   26.32053 -0.3115   0.7554
lag(T1_it, 1)        -10.97789   25.06062 -0.4381   0.6613
npl_loans_it          54.96010   46.27952  1.1876   0.2350
lag(npl_loans_it, 1)  15.51587   77.22132  0.2009   0.8408

Sargan test: chisq(512) = 1.651404 (p-value = 1)
Autocorrelation test (1): normal = -0.6585741 (p-value = 0.51017)
Autocorrelation test (2): normal = -0.5031866 (p-value = 0.61483)
Wald test for coefficients: chisq(13) = 36.8392 (p-value = 0.00043904)
```

Table 5.8

The two tables above represent both the Arellano & Bond estimation (GMM estimator) and the Blundell and Bond estimation (System GMM estimator) for the previously mentioned EU countries.

The estimation provided for this are not quite significant, only the Bad management II hypothesis, with a high significance level, $\alpha = 0.001\%$, with the simple GMM estimator.Is interesting, however, even if the results provided are not quite significant, to compare the

estimation of this sample with the one regarding the southern European countries, summarized in the following two tables.

The outcome of the tables below concerns the estimation of four European countries collocated in the south of Europe, such as: Italy, Greece, Portugal and Spain.

The banks included in the sample are specified in the paragraph 5.1 of this chapter.

```
Number of Observations Used: 160

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-16.82930  -2.59382   0.08374   0.32323   3.11244  17.70236

Coefficients:
                       Estimate  Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)       -1.4910e+00  7.6846e-01 -1.9402 0.0523531 .
unemp_it              4.6902e+02  3.7412e+02  1.2537 0.2099629
lag(unemp_it, 1)      4.4400e+01  4.0317e+01  1.1013 0.2707763
GDPgr_it              1.8413e+02  1.6349e+02  1.1263 0.2600534
lag(GDPgr_it, 1)      4.1961e+01  2.3448e+01  1.7895 0.0735346 .
ROE_it1               2.1707e+00  2.0622e+00  1.0526 0.2925200
lag(ROE_it1, 1)       2.8232e+00  3.0307e+00  0.9315 0.3515860
Loans_it1             6.6852e-01  1.7464e-01  3.8279 0.0001292 ***
lag(Loans_it1, 1)    -2.1357e-04  1.0926e-02 -0.0195 0.9844046
T1_it                 1.2170e+02  1.2820e+02  0.9493 0.3424666
lag(T1_it, 1)         1.0380e+02  1.1667e+02  0.8897 0.3736436
npl_loans_it          7.3494e+00  3.8457e-01 19.1108 < 2.2e-16 ***
lag(npl_loans_it, 1)  1.8737e+01  5.4041e+00  3.4671 0.0005261 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(64) = 1.19491 (p-value = 1)
Autocorrelation test (1): normal = -0.7100124 (p-value = 0.4777)
Autocorrelation test (2): normal = -0.9645949 (p-value = 0.33475)
Wald test for coefficients: chisq(13) = 177232.5 (p-value = < 2.22e-16)
```

Table 5.9

```
Number of Observations Used: 336

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-12.62039  -2.19450  -0.08106  -0.23867   1.63790  12.57478

Coefficients:
                       Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)       -1.809007   1.097223 -1.6487  0.099206 .
unemp_it            117.164453  53.156271  2.2042  0.027514 *
lag(unemp_it, 1)    173.108492 151.104811  1.1456  0.251953
GDPgr_it             42.153315  31.172008  1.3523  0.176285
lag(GDPgr_it, 1)     82.622542  59.972215  1.3777  0.168302
ROE_it1              -1.805678   1.594685 -1.1323  0.257504
lag(ROE_it1, 1)       0.359823   0.575470  0.6253  0.531795
Loans_it1             0.751058   0.265304  2.8309  0.004641 **
lag(Loans_it1, 1)    -0.021546   0.018762 -1.1484  0.250807
T1_it                61.479668  39.399115  1.5604  0.118658
lag(T1_it, 1)        23.495332  25.050139  0.9379  0.348279
npl_loans_it          6.860027   1.080056  6.3515 2.132e-10 ***
lag(npl_loans_it, 1) 20.576725   7.502264  2.7427  0.006093 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(512) = 4.212295 (p-value = 1)
Autocorrelation test (1): normal = -1.144574 (p-value = 0.25239)
Autocorrelation test (2): normal = -1.107996 (p-value = 0.26786)
Wald test for coefficients: chisq(13) = 31695.71 (p-value = < 2.22e-16)
```

Table 5.10

The outcomes, computed with GMM estimator in the first table and with system GMM estimator in the second one, are very different from the ones provided for the west European countries.

The estimation, indeed, confirm several hypotheses, such as, for the Arellano & Bond estimator: Lending Hypothesis, with a significance level of $\alpha = 0.001\%$, for the first lag if the variable; Bad management II hypothesis, with a significance level of $\alpha = 0.001\%$, both for the first and the second lag of the variable; the result evidence also a weak level of significance for the independent lagged variable GDP growth, highlighting a positive correlation with the independent variable NPL.

A statistical significance is found also in the lagged dependent NPL, in particular a negative correlation.

Analysing the results provided by the Blundell and Bond estimator, we can find additional hypothesis confirmed, such as: Lending hypothesis, with a significance level of $\alpha = 0{,}001\%$, for the first lag of the variable; Bad management II hypothesis, with a elevate significance level both for the first and the second lag; Unemployment rate hypothesis, with a significance level of $\alpha = 0{,}5\%$. Is really interesting that, for the southern countries, the unemployment rate and

GDP growth has a statistical significance on the amount of gross non-performing loans, since, as previously described, these countries face a huge macroeconomic stress during the sovereign debt crisis in 2011-2012 and this period have influenced also the credit quality of the borrowers. A statistical significance is found also in the lagged dependent NPL, in particular a negative relation.

The further analysis concerns other split, concerning the characteristic of the banks taken in the sample.

The first division is made in order to understand if the different size of the banks induce to different determinants of gross NPL level.
For size of the bank is meant the total asset held and the two sample are structured as: first split contains the bigger banks, in terms of asset, included in the sample; the second split comprise the smallest banks of the total sample.
The outcomes, for the bigger banks split, are reported in the following tables.

```
Number of Observations Used: 160

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-4.166305 -0.965027  0.002715  0.007730  0.969699  3.200018

Coefficients:
                     Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)        -0.68000    0.31087 -2.1874   0.02871 *
unemp_it              77.14433   93.75269  0.8228   0.41059
lag(unemp_it, 1)     -95.56513   74.58636 -1.2813   0.20010
GDPgr_it              17.93225   11.17282  1.6050   0.10850
lag(GDPgr_it, 1)     -11.92332   15.87392 -0.7511   0.45258
ROE_it1                2.23591    2.61918  0.8537   0.39329
lag(ROE_it1, 1)        1.43532    1.58407  0.9061   0.36488
Loans_it1             -1.75838    1.75803 -1.0002   0.31721
lag(Loans_it1, 1)     -1.60626    0.85573 -1.8771   0.06051 .
T1_it                -14.32283   17.93733 -0.7985   0.42458
lag(T1_it, 1)        -30.66282   33.56296 -0.9136   0.36093
npl_loans_it1         65.27694   16.64885  3.9208 8.825e-05 ***
lag(npl_loans_it1, 1) 68.74014   31.47777  2.1838   0.02898 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(64) = 0.1456003 (p-value = 1)
Autocorrelation test (1): normal = -0.7861882 (p-value = 0.43176)
Autocorrelation test (2): normal = -1.138523 (p-value = 0.2549)
Wald test for coefficients: chisq(13) = 176.4394 (p-value = < 2.22e-16)
```

Table 5.11

```
Number of Observations Used: 336

Residuals:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-3.5902 -0.4154  0.2632  0.2912  1.0132  4.1824

Coefficients:
                     Estimate Std. Error z-value Pr(>|z|)
lag(NPL_it, 1)        -0.36489    0.30956 -1.1787   0.2385
unemp_it              22.51608   59.31777  0.3796   0.7043
lag(unemp_it, 1)     -44.92086   54.02763 -0.8314   0.4057
GDPgr_it               4.88583   13.13001  0.3721   0.7098
lag(GDPgr_it, 1)     -12.44153   14.62604 -0.8506   0.3950
ROE_it1               -3.00282    3.89052 -0.7718   0.4402
lag(ROE_it1, 1)       -1.90016    4.48530 -0.4236   0.6718
Loans_it1             -1.43886    4.46692 -0.3221   0.7474
lag(Loans_it1, 1)      0.15800    1.80327  0.0876   0.9302
T1_it                -29.92920   30.90942 -0.9683   0.3329
lag(T1_it, 1)        -27.40432   24.50572 -1.1183   0.2634
npl_loans_it1         32.41933   29.97825  1.0814   0.2795
lag(npl_loans_it1, 1)  7.77673   42.94137  0.1811   0.8563

Sargan test: chisq(512) = 2.197586 (p-value = 1)
Autocorrelation test (1): normal = -0.662337 (p-value = 0.50776)
Autocorrelation test (2): normal = -0.9772554 (p-value = 0.32844)
Wald test for coefficients: chisq(13) = 21.49941 (p-value = 0.06362)
```

Table 5.12

The two tables represent the estimations computed both with GMM estimator, the first one, and with system GMM estimator, the second one.
Only the first model, Arellano & Bond, provide significant results for this split sample.
In particular, the estimation confirms the Bad management II hypothesis, with a high significance level. Is interesting, however, that, in this case, the lending hypothesis is different from what the literature reports.

The coefficient of the estimated parameter of the two periods lagged variable of variation of total loans is negative, with, however, a low significance level $\alpha = 0.1\%$, instead of positive, as suggested by several authors.

The reason could be found in the nature of the split analysed. Credit institutions which manage high level of assets, indeed, could have reduced their gross level of NPL since these institutions have more opportunity to diversify their activities and so to reduce also the risk of new loans granted since that type of asset is not the only way to make profit (Lousiz et al., 2011). A statistical significance is found also in the lagged dependent NPL, in particular a negative relation.

The model provided by Blundell and Bond, for this sample, however, does not estimate significance coefficients.

The following two tables concerns the estimation provided for the smaller banks sample:

```
Number of Observations Used: 160

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-6.124775 -1.130036  0.004148  0.224342  1.831376 15.006097

Coefficients:
                     Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)       -1.011770   0.699278 -1.4469   0.14793
unemp_it            291.780513 123.133636  2.3696   0.01781 *
lag(unemp_it, 1)     73.427809  51.830137  1.4167   0.15657
GDPgr_it             76.094490  34.825686  2.1850   0.02889 *
lag(GDPgr_it, 1)     42.436259  24.825771  1.7094   0.08738 .
ROE_it1               0.811713   0.579250  1.4013   0.16112
lag(ROE_it1, 1)       0.848200   0.616088  1.3768   0.16859
Loans_it1             0.512336   0.216313  2.3685   0.01786 *
lag(Loans_it1, 1)    -0.020403   0.012509 -1.6310   0.10289
T1_it                25.676092  29.306015  0.8761   0.38096
lag(T1_it, 1)        35.846325  32.762390  1.0941   0.27390
npl_loans_it1         7.033254   1.148303  6.1249 9.074e-10 ***
lag(npl_loans_it1, 1) 14.598952   5.740798  2.5430   0.01099 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(64) = 1.564735 (p-value = 1)
Autocorrelation test (1): normal = -0.7564256 (p-value = 0.44939)
Autocorrelation test (2): normal = -1.549335 (p-value = 0.1213)
Wald test for coefficients: chisq(13) = 61508.32 (p-value = < 2.22e-16)
```

Table 5.13

```
Number of Observations Used: 336

Residuals:
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-14.6283  -2.5127  -0.3296  -0.1551   2.1038  16.2943

Coefficients:
                     Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)       -0.794783   0.902573 -0.8806   0.37855
unemp_it             85.420641  99.264268  0.8605   0.38949
lag(unemp_it, 1)    192.788082 209.971841  0.9182   0.35853
GDPgr_it             59.985231  32.023599  1.8732   0.06105 .
lag(GDPgr_it, 1)    144.942339 135.675803  1.0683   0.28539
ROE_it1               0.899578   0.378790  2.3749   0.01756 *
lag(ROE_it1, 1)      -0.825108   0.927111 -0.8900   0.37348
Loans_it1             0.393787   0.258963  1.5206   0.12835
lag(Loans_it1, 1)    -0.017127   0.016778 -1.0208   0.30734
T1_it                60.291741  37.034213  1.6280   0.10352
lag(T1_it, 1)        25.048280  23.705566  1.0566   0.29068
npl_loans_it1         6.306529   1.553588  4.0593 4.921e-05 ***
lag(npl_loans_it1, 1) 10.600216   6.778646  1.5638   0.11787
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(512) = 3.375108 (p-value = 1)
Autocorrelation test (1): normal = -0.5382656 (p-value = 0.59039)
Autocorrelation test (2): normal = -0.7586272 (p-value = 0.44808)
Wald test for coefficients: chisq(13) = 235.3192 (p-value = < 2.22e-16)
```

Table 5.14

The analysis provides different results from the one made for the bigger banks.

In particular, under the Arellano and Bond estimation, are confirmed these hypotheses: Unemployment rate hypothesis, with a significance level of $\alpha = 0{,}1\%$, for the variation on unemployment rate of the current year; bad management hypothesis II, with a significance level of $\alpha = 0.001\%$ for the first lag and $\alpha = 0{,}5\%$ for the second lag; the GDP growth coefficient has a positive sign and the explanation of this effect is the same as descripted above.

What is interesting is that, in this case, the lending hypothesis is confirmed for the smallest banks, in contrary with respect to the outcome of the previous estimation.
This support the motivation of the behaviour of this independent variable on the gross level of NPL.
Analysing the results of the estimation computed with the 'system GMM estimator', can be found similar results with respect to the ones reported by the Arellano & Bond estimator.
In particular, with this model the hypotheses confirmed are: Bad management II hypothesis, with a significance level of α = 0.001% for the first lag of the variable; Procyclical credit hypothesis, with a significance level of α = 0.05% for the first lag of the variable; GDP growth rate hypothesis is not confirmed since the coefficient has an opposite sign with respect to what expected and the explanation of this effect is explained in the description of the estimation of the total sample.

The next split is mad in order to understand if banks more efficient and less efficient have different determinants of the variation of gross level of NPL.
The efficiency of the banks is computed with the cost-to-income ratio, expressed as the ration between the operating expenses over operating income.
As more efficient banks are intended those bank who record the lowest level of the ration, basing on the total sample; in contrary, the banks less efficient are the ones who report a high level of the ratio in the sample. The banks included in the split are summarized in the table on the paragraph 5.1 of this chapter.
The table below report the estimation for the sample of efficient banks.

```
Residuals:
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-4.21440 -0.83288  0.09476  0.28485  1.44720  8.81007

Coefficients:
                      Estimate  Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)        -1.0597901   0.3930422 -2.6964   0.00701 **
unemp_it             177.7947785  75.4001785  2.3580   0.01837 *
lag(unemp_it, 1)     100.5294459  68.3627897  1.4705   0.14142
GDPgr_it              56.5544463  37.0766470  1.5253   0.12717
lag(GDPgr_it, 1)      52.1897432  28.4245375  1.8361   0.06635 .
ROE_it1               -0.0883725   0.4052772 -0.2181   0.82739
lag(ROE_it1, 1)        0.0228574   0.6259384  0.0365   0.97087
Loans_it1              0.6034233   0.1150281  5.2459 1.555e-07 ***
lag(Loans_it1, 1)     -0.0146298   0.0093616 -1.5627   0.11811
T1_it                -13.2892723  33.8546632 -0.3925   0.69466
lag(T1_it, 1)          8.9369403  23.0482142  0.3877   0.69820
npl_loans_it1          7.5780459   0.5214207 14.5335 < 2.2e-16 ***
lag(npl_loans_it1, 1) 16.2995830   3.1550812  5.1661 2.390e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(64) = 0.5991126 (p-value = 1)
Autocorrelation test (1): normal = -0.2642258 (p-value = 0.79161)
Autocorrelation test (2): normal = -1.478619 (p-value = 0.13924)
Wald test for coefficients: chisq(13) = 55768.58 (p-value = < 2.22e-16)
```

Table 5.15

```
Residuals:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-7.8076 -1.1109 -0.1104 -0.1766  0.8312  5.5686

Coefficients:
                      Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)        -0.068182   0.724998 -0.0940    0.9251
unemp_it              46.672931  87.288767  0.5347    0.5929
lag(unemp_it, 1)     -47.520863 186.100164 -0.2554    0.7985
GDPgr_it              35.988533  72.469578  0.4966    0.6195
lag(GDPgr_it, 1)       7.381116  82.367362  0.0896    0.9286
ROE_it1                0.847291   2.652590  0.3194    0.7494
lag(ROE_it1, 1)        0.019465   0.715986  0.0272    0.9783
Loans_it1              0.460378   0.305849  1.5052    0.1323
lag(Loans_it1, 1)      0.019997   0.022094  0.9051    0.3654
T1_it                 24.443224  86.072832  0.2840    0.7764
lag(T1_it, 1)         21.280251  76.058725  0.2798    0.7796
npl_loans_it1          9.706180   1.453667  6.6770 2.438e-11 ***
lag(npl_loans_it1, 1) 10.968814   6.847457  1.6019    0.1092
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(512) = 6.874051 (p-value = 1)
Autocorrelation test (1): normal = -0.08215893 (p-value = 0.93452)
Autocorrelation test (2): normal = -0.3590398 (p-value = 0.71957)
Wald test for coefficients: chisq(13) = 21382.33 (p-value = < 2.22e-16)
```

Table 5.16

The estimation made with the Arellano & Bond technique confirm several hypotheses for this sample, such as: Unemployment rate hypothesis, with a significance level of $\alpha = 0.01\%$, for the variable in time *t*; Lending hypothesis, with a significance level of $\alpha = 0.001\%$, for the variable lagged for one period; Bad management II hypothesis, with a significance level of $\alpha = 0.001\%$, for both the first and the second lag of the variable.

The GDP growth coefficient, however, is positive, so do not confirm the GDP growth hypothesis. The explanation of this behaviour is the same as the one over mentioned, in the description of the full sample, at the beginning of this paragraph. A statistical significance is found also in the lagged dependent NPL, in particular a negative relation.

The result provided by the Blundell and Bond estimator are not quite significant.

In this model, for this sample, the only hypothesis confirmed is the bad management II hypothesis, with a level of significance of $\alpha = 0.001\%$ for the first lag of the variable.

In order to understand if there are differences between the efficient banks and the less efficient ones, in the table below I have reported the outcomes provided for the less efficient banks sample.

```
Residuals:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-6.5075 -0.6266 -0.1388 -0.1103  0.4692  3.8619

Coefficients:
                      Estimate Std. Error z-value Pr(>|z|)
lag(NPL_it, 1)        -0.986417   0.410441 -2.4033 0.016247 *
unemp_it              -98.158602 105.915443 -0.9268 0.354049
lag(unemp_it, 1)      -74.753488 106.642703 -0.7010 0.483321
GDPgr_it              -14.530855  18.858557 -0.7705 0.440993
lag(GDPgr_it, 1)      -24.478939  34.172958 -0.7163 0.473791
ROE_it1                 0.075102   0.388559  0.1933 0.846737
lag(ROE_it1, 1)         0.174524   0.435853  0.4004 0.688847
Loans_it1              -0.378773   0.812343 -0.4663 0.641020
lag(Loans_it1, 1)      -0.901043   1.031721 -0.8733 0.382478
T1_it                  -3.723077  13.598782 -0.2738 0.784254
lag(T1_it, 1)           4.440005  29.464585  0.1507 0.880221
npl_loans_it1          54.016349  17.084682  3.1617 0.001569 **
lag(npl_loans_it1, 1)  46.012782  26.287675  1.7504 0.080057 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(64) = 1.484667 (p-value = 1)
Autocorrelation test (1): normal = 0.1561598 (p-value = 0.87591)
Autocorrelation test (2): normal = -1.961698 (p-value = 0.049798)
Wald test for coefficients: chisq(13) = 99.49656 (p-value = 2.0767e-15)
```

Table 5.17

```
Residuals:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-5.7425 -0.8692  0.6595  0.5542  1.7634  7.0735

Coefficients:
                      Estimate Std. Error z-value Pr(>|z|)
lag(NPL_it, 1)         -0.75732    0.39893 -1.8984  0.05764 .
unemp_it             -166.82581  116.90521 -1.4270  0.15357
lag(unemp_it, 1)     -170.96990  217.73057 -0.7852  0.43232
GDPgr_it              -24.67800   16.62706 -1.4842  0.13775
lag(GDPgr_it, 1)      -71.33758   78.90090 -0.9041  0.36592
ROE_it1                -1.93219    1.30953 -1.4755  0.14008
lag(ROE_it1, 1)        -1.28261    0.76944 -1.6669  0.09553 .
Loans_it1              -0.38720    1.64669 -0.2351  0.81410
lag(Loans_it1, 1)       0.50302    1.20991  0.4158  0.67759
T1_it                 -22.81739   31.79084 -0.7177  0.47292
lag(T1_it, 1)         -25.81449   35.47442 -0.7277  0.46680
npl_loans_it1          49.26490   31.55628  1.5612  0.11848
lag(npl_loans_it1, 1)  30.45201   19.31648  1.5765  0.11492
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(512) = 0.8353702 (p-value = 1)
Autocorrelation test (1): normal = -0.9661794 (p-value = 0.33395)
Autocorrelation test (2): normal = -0.801228 (p-value = 0.423)
Wald test for coefficients: chisq(13) = 170.7535 (p-value = < 2.22e-16)
```

Table 5.18

In the table above are reported the result of the two estimators.

In particular, in the first estimation, computed with the Arellano & Bond estimator, is confirmed only the bad management II hypothesis, with a significance level of $\alpha = 0.01\%$ for the first lag of the NPL/total loans variable and of $\alpha = 0.1\%$ for the second lag of the same variable. A statistical significance is found also in the lagged dependent NPL, in particular a negative relation.

The second model, the one estimated with the Blundell and Bond technique, furnishes different results.

In particular, the hypothesis confirmed for the less efficient banks is the bad management hypothesis, with the statistical significance of the first lag of the independent variable ROE with $\alpha = 0.1\%$. A statistical significance is found also in the lagged dependent NPL, in particular a negative relation.

The two sample, hence, provide different outcomes, so the different nature of the banks has also different determinants of impaired assets held by the institutions.

In particular, the more efficient banks have a higher registered effect of the macroeconomic environment, since the unemployment rate affects the variation of the level of gross NPL.

The bank-specific effects, instead, affect both the categories, but in a different way.

The NPL handled by the less efficient banks, indeed, are affected by the performances of the bank's themselves, but not from the lending cycle, which affect, instead, the more efficient ones.

The last split concerning the characteristics of the banks is the one made for distinguish the effect of the independent variables on the make more capitalized or less capitalized.

The threshold is made according to the T1 ratio. In particular, the banks included in the sample of capitalized banks are the ones whom reported the higher T1 ratio in the sample, the less capitalized ones the opposite.

In the following table are reported the outcomes of the capitalized banks.

```
Number of Observations Used: 160

Residuals:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-5.4999 -0.8162 -0.0400 -0.1248  0.5357  4.1216

Coefficients:
                       Estimate Std. Error z-value Pr(>|z|)
lag(NPL_it, 1)         -0.641370   0.565077 -1.1350   0.2564
unemp_it                3.101426 100.476000  0.0309   0.9754
lag(unemp_it, 1)      -18.994131 116.938524 -0.1624   0.8710
GDPgr_it              -12.568544  23.605948 -0.5324   0.5944
lag(GDPgr_it, 1)        2.737158   9.581145  0.2857   0.7751
ROE_it1                -0.044905   0.389288 -0.1154   0.9082
lag(ROE_it1, 1)         0.055989   0.466648  0.1200   0.9045
Loans_it1              -2.838646   1.759308 -1.6135   0.1066
lag(Loans_it1, 1)      -0.920608   0.974358 -0.9448   0.3447
T1_it                  -0.641902  20.401227 -0.0315   0.9749
lag(T1_it, 1)           5.920869   5.498282  1.0769   0.2815
npl_loans_it1         -10.988053  39.714687 -0.2767   0.7820
lag(npl_loans_it1, 1) -36.449198  64.975891 -0.5610   0.5748

Sargan test: chisq(64) = 1.437082 (p-value = 1)
Autocorrelation test (1): normal = -1.971964 (p-value = 0.048614)
Autocorrelation test (2): normal = -1.941427 (p-value = 0.052206)
Wald test for coefficients: chisq(13) = -28.70412 (p-value = 1)
```

Table 5.19

```
Number of Observations Used: 336

Residuals:
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
-3.2569 -0.3431  0.1750  0.2314  0.7397  4.5149

Coefficients:
                       Estimate Std. Error z-value Pr(>|z|)
lag(NPL_it, 1)         -0.29742    0.32058 -0.9277   0.3535
unemp_it               41.92171   95.27444  0.4400   0.6599
lag(unemp_it, 1)      -38.69089   60.60247 -0.6384   0.5232
GDPgr_it                0.19516   21.94159  0.0089   0.9929
lag(GDPgr_it, 1)        4.73793   20.52188  0.2309   0.8174
ROE_it1                 0.50542    0.61160  0.8264   0.4086
lag(ROE_it1, 1)         0.36616    0.71892  0.5093   0.6105
Loans_it1              -2.12327    3.06700 -0.6923   0.4888
lag(Loans_it1, 1)      -0.16452    1.15010 -0.1430   0.8863
T1_it                  -5.01123   24.87149 -0.2015   0.8403
lag(T1_it, 1)           7.51919   23.02901  0.3265   0.7440
npl_loans_it1          -4.67884   15.49863 -0.3019   0.7627
lag(npl_loans_it1, 1) -13.76589   23.18188 -0.5938   0.5526

Sargan test: chisq(512) = 3.780702 (p-value = 1)
Autocorrelation test (1): normal = -1.059179 (p-value = 0.28952)
Autocorrelation test (2): normal = -1.166873 (p-value = 0.24326)
Wald test for coefficients: chisq(13) = 30.06257 (p-value = 0.0046129)
```

Table 5.20

Unfortunately, both the estimator, in the split of capitalized banks, does not provide statistically significance of no one of the independent variable included in the model.
However, is still interesting to understand the determinants of NPL on the sample of less capitalized banks.

The table below reports the outcomes provided by the analysis of the latter sample.

```
Residuals:
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-5.43531 -0.73342  0.09233  0.06748  0.79321  4.74651

Coefficients:
                       Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)       -0.7266009  0.4701723 -1.5454  0.122251
unemp_it             81.6313353 94.0269229  0.8682  0.385301
lag(unemp_it, 1)     36.2839285 69.4317418  0.5226  0.601264
GDPgr_it             33.5218215 41.2300164  0.8130  0.416193
lag(GDPgr_it, 1)     36.7077385 16.8025144  2.1847  0.028914 *
ROE_it1              -0.9101959  2.4609302 -0.3699  0.711488
lag(ROE_it1, 1)      -2.8987697  3.6070100 -0.8036  0.421600
Loans_it1             0.5556823  0.1830607  3.0355  0.002401 **
lag(Loans_it1, 1)    -0.0061948  0.0160466 -0.3860  0.699462
T1_it                -7.1939659 33.7975809 -0.2129  0.831440
lag(T1_it, 1)        -8.6542625 35.9163446 -0.2410  0.809589
npl_loans_it1         8.3050235  0.7880316 10.5389 < 2.2e-16 ***
lag(npl_loans_it1, 1) 14.4318851  4.4425613  3.2486  0.001160 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(64) = 3.188552 (p-value = 1)
Autocorrelation test (1): normal = -0.5302711 (p-value = 0.59592)
Autocorrelation test (2): normal = -1.303778 (p-value = 0.19231)
Wald test for coefficients: chisq(13) = 4956784 (p-value = < 2.22e-16)
```

Table 5.21

```
Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-13.83860  -0.98441  -0.06542  -0.12913   0.79097  12.69944

Coefficients:
                       Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)       -0.412788   0.592686 -0.6965   0.48613
unemp_it             23.521286  37.278425  0.6310   0.52807
lag(unemp_it, 1)    -27.146483 103.977480 -0.2611   0.79403
GDPgr_it             12.434955  49.184024  0.2528   0.80040
lag(GDPgr_it, 1)     27.778401  40.917906  0.6789   0.49721
ROE_it1              -5.131694   6.065408 -0.8461   0.39752
lag(ROE_it1, 1)      -6.987620   7.387136 -0.9459   0.34419
Loans_it1             0.498418   0.228692  2.1794   0.02930 *
lag(Loans_it1, 1)     0.012693   0.018811  0.6748   0.49981
T1_it               -31.735934  74.829919 -0.4241   0.67149
lag(T1_it, 1)        35.176216  83.121429  0.4232   0.67216
npl_loans_it1         8.776487   1.403112  6.2550 3.975e-10 ***
lag(npl_loans_it1, 1) 12.872895   5.709316  2.2547   0.02415 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(512) = 3.503133 (p-value = 1)
Autocorrelation test (1): normal = -0.6592529 (p-value = 0.50973)
Autocorrelation test (2): normal = 0.3724821 (p-value = 0.70953)
Wald test for coefficients: chisq(13) = 26115.04 (p-value = < 2.22e-16)
```

Table 5.22

The first table furnishes the outcome estimated with the Arellano and Bond estimator.
The confirmed hypotheses, under this approach, are: Lending hypothesis, with a significance level of $\alpha = 0.01\%$, for the first lag of the independent variable; Bad management II hypothesis II, with a significance level of $\alpha = 0.001\%$ for the first lag of the independent variable and of $\alpha = 0.01\%$ for the second lag of the independent variable.
The estimation provides also a statistic significance for the first lag of GDP growth, but the estimated coefficient is positive, so does not confirm the GDP growth hypothesis.
The other model, the one implemented by Blundell and Bond, are confirmed the same hypothesis as in the Arellano and Bond estimation, but with different significance levels.
In particular, the Lending hypothesis is confirmed with $\alpha = 0.05\%$ for the first lag of the independent variable and the Bad management II hypothesis is confirmed with a significance level $\alpha = 0.001\%$ for the first lag and $\alpha = 0.05\%$ for the second lag of the independent variable.
Unfortunately, is not possible to compare the two split, since the first one does not provide statistical significance of the independent variable chosen.

However, the less capitalized banks are affected by both the macroeconomics and bank-specific factors, underlining that both the economic situation and the behaviour of the management of the bank affects the level of gross NPL of these category of banks.

The last split of the sample does not concern the bank's characteristic or the countries characteristic but is a time split.

In particular, I have wanted to split the total sample into two bands of years, in order to investigate if the determinants of non-performing loans are different between the years from 2008 to 2012, the years in which the effects of the financial crisis and the sovereign debt crisis were higher, and the year between 2013 to 2017, in which the effects of the crisis have eased.

In the table below are reported the outcomes of the crisis period, so from 2008 to 2012.

```
Number of Observations Used: 128

Residuals:
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
-2.624790 -0.348374  0.011850 -0.009222  0.371916  3.064598

Coefficients:
                       Estimate Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)         -0.256846   0.074432 -3.4507 0.0005591 ***
unemp_it               22.698573   9.246604  2.4548 0.0140963 *
lag(unemp_it, 1)      -16.717975  10.228084 -1.6345 0.1021504
GDPgr_it                3.435993   2.397739  1.4330 0.1518539
lag(GDPgr_it, 1)        7.373729   3.561605  2.0703 0.0384206 *
ROE_it1                -0.084085   0.476851 -0.1763 0.8600318
lag(ROE_it1, 1)        -0.605427   0.602546 -1.0048 0.3150017
Loans_it1               0.251589   0.443138  0.5677 0.5702086
lag(Loans_it1, 1)       0.568496   0.275150  2.0661 0.0388160 *
T1_it                   2.247167   3.030971  0.7414 0.4584500
lag(T1_it, 1)           1.656206   4.179020  0.3963 0.6918730
npl_loans_it1           8.868538   0.091128 97.3196 < 2.2e-16 ***
lag(npl_loans_it1, 1)  11.212418   0.682893 16.4190 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(13) = 22.07914 (p-value = 0.054148)
Autocorrelation test (1): normal = -2.207489 (p-value = 0.02728)
Autocorrelation test (2): normal = 0.7824496 (p-value = 0.43395)
Wald test for coefficients: chisq(13) = 13541416 (p-value = < 2.22e-16)
```

Table 5.23

```
Number of Observations Used: 288

Residuals:
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-2.94731 -0.26367 -0.01409  0.02144  0.29902  3.05929

Coefficients:
                       Estimate Std. Error z-value Pr(>|z|)
lag(NPL_it, 1)         -0.082608   0.063134 -1.3085  0.19071
unemp_it               22.578020  11.881177  1.9003  0.05739 .
lag(unemp_it, 1)      -10.238994  11.369683 -0.9006  0.36783
GDPgr_it                3.684122   2.486021  1.4819  0.13836
lag(GDPgr_it, 1)        7.262043   3.673008  1.9771  0.04803 *
ROE_it1                -0.385206   0.649179 -0.5934  0.55293
lag(ROE_it1, 1)        -0.488140   0.510773 -0.9557  0.33923
Loans_it1               0.143639   0.454861  0.3158  0.75216
lag(Loans_it1, 1)       0.363501   0.301175  1.2069  0.22745
T1_it                   4.890589   3.999299  1.2229  0.22138
lag(T1_it, 1)           3.996173   7.423340  0.5383  0.59035
npl_loans_it1           8.737386   0.144750 60.3619  < 2e-16 ***
lag(npl_loans_it1, 1)   9.429024   0.556024 16.9579  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(113) = 22.35526 (p-value = 1)
Autocorrelation test (1): normal = -2.293296 (p-value = 0.021831)
Autocorrelation test (2): normal = 1.540229 (p-value = 0.1235)
Wald test for coefficients: chisq(13) = 514119 (p-value = < 2.22e-16)
```

Table 5.24

The estimation made with GMM estimator confirms several hypothesis, such as: Unemployment rate hypothesis, with a significance level of $\alpha = 0.05\%$ on the non-lagged independent variable; Lending hypothesis, in which the significance level is equal to $\alpha = 0.05\%$ for the second lag of the independent variable; Bad management II hypothesis, whit a significance level of $\alpha = 0.001\%$ both for the first and the second lag of the independent variable.

A statistical significance, with $\alpha = 0.05\%$, is found also on the first lag of the independent variable GDP growth. The estimated coefficient, however, has a positive sign, so the GDP growth hypothesis are not confirmed. The meaning of a positive correlation of GDP growth is explained at the begging of this paragraph, in the description of the estimation of the total

sample. A statistical significance is found also in the lagged dependent NPL, in particular a negative relation.

The estimation provided from the other model, the one implemented by Blundell and Bond are similar, but with different significance.
In particular, system GMM estimator confirm: Unemployment rate hypothesis, with a significance level of $\alpha = 0.1\%$ for the non-lagged independent variable; Bad management II hypothesis, with a significance level of $\alpha = 0.001\%$ for both the lags of the variable.
The estimator provide a significance of $\alpha = 0.05\%$ for the independent variable GDP growth, but with the opposite sign of what was expected. The reasoning under this estimation is the same of the one founded on the total sample estimation and is briefly described in that section. The further table will report the outcome of the post crisis period.

```
Number of Observations Used: 128

Residuals:
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-2.57548 -0.18670  0.02186  0.01442  0.21451  4.80414

Coefficients:
                      Estimate  Std. Error z-value  Pr(>|z|)
lag(NPL_it, 1)       -0.29466912  0.08105813 -3.6353 0.0002777 ***
unemp_it             21.09341642 15.61292362  1.3510 0.1766881
lag(unemp_it, 1)     -0.90401783 10.74059995 -0.0842 0.9329226
GDPgr_it             -1.24731904  4.57112958 -0.2729 0.7849540
lag(GDPgr_it, 1)     -2.57180373  4.83597411 -0.5318 0.5948598
ROE_it1               0.02026234  0.09227098  0.2196 0.8261858
lag(ROE_it1, 1)       0.09079416  0.08254749  1.0999 0.2713747
Loans_it1            -0.53588563  0.65318677 -0.8204 0.4119783
lag(Loans_it1, 1)    -0.00062267  0.00344290 -0.1809 0.8564801
T1_it                -0.58164128  2.58763747 -0.2248 0.8221528
lag(T1_it, 1)        -3.23933851  2.48842272 -1.3018 0.1929972
npl_loans_it1         6.09498825  3.57733104  1.7038 0.0884220 .
lag(npl_loans_it1, 1) -0.27335405  1.50158680 -0.1820 0.8555486
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(13) = 18.2799 (p-value = 0.14718)
Autocorrelation test (1): normal = -1.288521 (p-value = 0.19756)
Autocorrelation test (2): normal = -1.137748 (p-value = 0.25523)
Wald test for coefficients: chisq(13) = 57.71914 (p-value = 1.3387e-07)
```

Table 5.25

```
Number of Observations Used: 288

Residuals:
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-4.62561 -0.14471  0.00738  0.06482  0.20560  5.65274

Coefficients:
                      Estimate  Std. Error z-value Pr(>|z|)
lag(NPL_it, 1)       -6.0280e-02  5.4311e-02 -1.1099  0.26705
unemp_it              2.0594e+01  1.1890e+01  1.7321  0.08326 .
lag(unemp_it, 1)      4.2604e+00  7.2809e+00  0.5851  0.55845
GDPgr_it              5.0634e+00  5.6282e+00  0.8996  0.36831
lag(GDPgr_it, 1)     -2.0894e+00  4.1141e+00 -0.5079  0.61155
ROE_it1               2.2944e-02  6.7032e-02  0.3423  0.73213
lag(ROE_it1, 1)       7.6274e-02  4.6164e-02  1.6522  0.09849 .
Loans_it1             5.2643e-02  3.2122e-01  0.1639  0.86982
lag(Loans_it1, 1)    -8.5235e-05  9.5335e-04 -0.0894  0.92876
T1_it                 4.1167e-01  2.1000e+00  0.1960  0.84459
lag(T1_it, 1)        -1.1682e+00  2.5063e+00 -0.4661  0.64113
npl_loans_it1         2.7445e+00  1.6351e+00  1.6785  0.09325 .
lag(npl_loans_it1, 1) -1.7242e+00  1.2100e+00 -1.4250  0.15415
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Sargan test: chisq(113) = 19.36897 (p-value = 1)
Autocorrelation test (1): normal = -1.771244 (p-value = 0.07652)
Autocorrelation test (2): normal = -1.21673 (p-value = 0.22371)
Wald test for coefficients: chisq(13) = 276.5825 (p-value = < 2.22e-16)
```

Table 5.26

The estimation, implemented with Arellano & Bond estimator, confirms only the Bad management II hypothesis, with a significance level of $\alpha = 0.1\%$ for the first lag of the independent variable and a statistical significance is found also in the lagged dependent NPL, in particular a negative relation.

The Blundell and Bond estimator, instead, confirms the same hypothesis with the same significance level but also confirms the Unemployment rate hypothesis, with a significance level of $\alpha = 0.1\%$ for the on-lagged independent variable.

The estimation provides also a significance relevance of α = 0.1% for the GDP growth independent variable, in particular for the first lag of the variable, with a positive sign of the estimated coefficient.
The split just analysed in particularly interesting since investigate the effect of the independent variables in two critical band of years, the first in which the economic environment was particularly stressed and the second in which the countries included in the sample faced a period of recovery.

The effect, indeed, are different and also the significance, underlining that, in the years between 2008 and 2012, the credit institutions faces several problems with the non-performing loans, given by both the macroeconomic variables, so determinants that the banks can't control, but also from bank-specific factors, in which the bank's management should have been more efficient and prudent.

Conclusions

The main aim of my analysis was to understand and underline the principal determinants of Non-Performing Loans in European Union banks, in order to highlight which macroeconomic and banks-specific factors affects the increase or decrease of bad loans held by the credit institutions.
Beside understanding which were the main causes of the variation of gross level of impaired loans, moreover, I have wanted underline which could be the possible causes, analysing the economic European environment in the years taken into analysis and provide possible solutions for the problem, according to the lines implemented by the European Banking Authority (EBA) and the Bank for International Settlement.

In the first section of my thesis, indeed, I have reported which are the main tools for managing this type of asset and the history behind the evolution of impaired asset in Europe.
Is important to underline the historical moment of the analysis since the economic scenario was highly stressed by financial and sovereign debt crisis and, in this particular environment, the managers of the banks have to put particular attention on the strategies implemented, since, as results and evidence underlines, the profitability and soundness of the credit institutions were seriously eroded by the financial distress.

Given these assumptions, the objective of my master thesis was to continue the investigation, made by several authors, on the main factor affecting the annual variation of gross stock of Non-Performing Loans held by banks in their balance sheets, in order to understand which nature has the issue and what are the possible solutions.
In particular, the hypotheses set up in the dissertation follows the ones provided by other authors, and several of those has been confirmed in the analysis, implemented with both the GMM estimator and the system GMM estimator.
Focusing on the hypothesis, I have found significance on both the macroeconomic variables, suggesting that the economic environment influences the gross stock of the bad loans and the borrower's capability of respect their debt (Klein (2013)).
In particular, I have confirmed, in the analysis, the unemployment rate hypothesis, in the estimation of the total sample, underlining a positive correlation between the annual change of unemployment rate and the annual change of gross NPL stock, since, if the borrowers loses or did not find a job, they will also lose the capability of repay their debts.

The hypothesis is also confirmed for the sample including only the southern European countries, for the ones which includes the smaller banks; the most efficient banks; the sample which includes the crisis period and the one which includes the post crisis period.
The result found in my analysis are in line with the estimation made by other authors, which analyse different sample, such as the CESEE countries (Klein, 2013), or the Euro banking-system (Makri et al., 2014; Dimitros et al., 2016; Messai et al., 2013) but including a different time horizon.
Concerning the other macroeconomic variable, the annual GDP growth rate, I have not confirmed the hypothesis formulated, but I have found a positive correlation between the latter variable, in the first lag, and the annual variation of gross NPL's stock.
The estimated result, indeed, is not in line with most of the research made, since an increase in GDP growth rate should reflect an improved economic situation for the borrowers, which might have lower difficulties repaying their obligations. According to what found by other researchers (Ranjan et al., 2003), however, the reason behind this outcome is that, in a period of improved economic conditions, the lenders should implement riskier strategies, justified by the positive economic trend, but this will reflect a higher stock of NPL for the next year.

Beside the results found on the macroeconomic variable, in the model implemented for my master thesis, I have found also statistical significance on bank-specific variables.
Those variables, attributable to bank managers' choices, have a huge influence on the quality of the loans (Makri et al., 2013).
The outcomes of my analysis confirms some of the hypotheses formulated, in line with the results of the models implemented by other authors.
In particular, according to the estimation made with GMM estimator and system GMM estimator, I have confirmed the lending hypothesis, finding a positive correlation between the annual change of loans issued by credit institutions and the annual change of gross NPL' stock.
The same result was found for the banks collocated in CESEE countries (Klein, 2013) and in the Italian banks (Milani, 2017), enhancing the hypothesis expressed in this dissertation.
Another bank-specific variable analysed is the profitability of the bank, which could have both positive (Lousiz et al., 2011; Milani, 2017) or negative (Klein, 2013; Makri et al., 2013; Lousiz et al., 2011; Milani, 2017; Abid et al., 2013) correlation with the dependent variable.
The bad management hypothesis, accepted when annual change in Return on Equity have a negative impact on annual variation of gross NPL stock, is confirmed under my analysis, in particular was found a statistical significance only in the split of less efficient banks.

The procyclical credit hypothesis, accepted when annual change in ROE have a positive effect on annual change of NPL stock, is also confirmed in my estimations, underlining that the profitability of the bank could raise the NPL level if the managers took riskier positions according to the higher profit made the previous year.

The last, bank-specific, hypothesis confirmed under my analysis is the Bad management II hypothesis.

This postulation analyses if the risk behaviour of the bank's lending management influences the riskiness of the loans portfolio held by the banks through the years, so if the strategies chosen in the previous year and two years ago affects the current annual change of impaired assets. The variable chosen for understand this behaviour is the annual change of gross NPL over total loans ratio.

The output found in my investigation confirms the hypothesis, since was found a positive correlation between additional risk taking by the lenders and the increase in gross NPL's stock.

Concluding, almost all of my hypotheses where confirmed in my analysis and follows the findings of other authors, so are in line with the literature available on this particular and delicate type of loans.

In my research, moreover, I have followed the current literature, exploiting the other research for implementing the analysis and the hypotheses to test, but I have also set up my thesis in order to understand if a different sample, comparing on the ones used in the literature, could have produced similar results and the estimation confirms that, even with a different sample, split in other sub-samples, identifies similar determinants of Non-Performing Loan in the European scenario.

The final aim, moreover, was not only the analysis of the determinants of Non-Performing Loans in the European countries, but also I wanted to try to provide some possible solutions and strategies to solve this burden, which has cause several problems to the soundness and the profitability of several financial institutions and to the sustainability of the national financial system.

The research, however, can be further implemented by adding more independent variables for better understanding which factors affects and determines the Non-Performing Loans.

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